
CLAIMS

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(57) [Claim(s)]

[Claim 1] On a piezo-electric substrate, the comb mold polar zone which has two or more electrode fingers meets in the propagation direction of a surface acoustic wave. Are surface acoustic wave equipment of plurality and the vertical joint resonator mold currently formed, and at least one goes away, and, otherwise, about the mold polar zone the pitch of some electrode fingers from the edge which goes away and adjoins the mold polar zone It is surface acoustic wave equipment characterized by being set up smaller than the pitch of other parts and setting up smaller than the duty of the electrode finger of other parts the duty of the electrode finger which made said pitch small.

[Claim 2] As opposed to the comb mold polar zone of both which adjoin each other mutually in surface acoustic wave equipment according to claim 1 It is the wavelength decided by the pitch of lambdaI2 and other electrode fingers in the wavelength decided by the pitch of the electrode finger which the electrode finger which changed the pitch is formed [finger], respectively and changed said pitch lambdaI1 When it carries out, It is the electrode finger pitch with which two go away and which the mold polar zone adjoins 0.5lambdaI2 Surface acoustic wave equipment characterized by carrying out abbreviation coincidence.

[Claim 3] In surface acoustic wave equipment according to claim 1, the electrode finger which changed the pitch is formed in either of each comb mold polar zone

which adjoins each other mutually. It is the wavelength decided by the pitch of lambdaI2 and other electrode fingers in the wavelength decided by the pitch of the electrode finger which changed said pitch lambdaI1 When it carries out, It is the electrode finger pitch with which two go away and which the mold polar zone adjoins 0.25lambdaI1+0.25lambdaI2 Surface acoustic wave equipment characterized by carrying out abbreviation coincidence.

[Claim 4] In the comb mold polar zone which changed the pitch of some electrode fingers from the edge where said comb mold polar zone adjoins with the pitch of other electrode fingers of the comb mold polar zone in surface acoustic wave equipment according to claim 2 or 3 It is the electrode finger pitch of the part where the electrode finger which is not changed with the electrode finger which changed said pitch adjoins each other 0.25lambdaI1+0.25lambdaI2 Surface acoustic wave equipment characterized by carrying out abbreviation coincidence.

[Claim 5] Surface acoustic wave equipment characterized by having been smaller than the duty of the electrode finger of other parts of the comb mold polar zone, and making or more into 0.45 duty of the electrode finger which made said pitch small in surface acoustic wave equipment given in any [claim 1 thru/or] of 4 they are.

[Claim 6] On a piezo-electric substrate, the comb mold polar zone which has two or more electrode fingers meets in the propagation direction of a surface acoustic wave. The duty of the electrode finger which is surface acoustic wave equipment of plurality and the vertical joint resonator mold currently formed, and it is in any at least and which goes away two and adjoins each other between mold polar zone is set up smaller than the duty of the electrode finger of other parts. Surface acoustic wave equipment characterized by setting up smaller than electrode finger core spacing (electrode finger pitch) of other parts electrode finger core spacing which goes away two and adjoins each other between mold polar zone.

[Claim 7] Surface acoustic wave equipment characterized by having balanced - unbalance I/O in surface acoustic wave equipment given in any [claim 1 thru/or]

of 6 they are. [Claim 8] The communication device characterized by using surface acoustic wave equipment given in any [claim 1 thru/or] of 7 they are.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.

2.**** shows the word which can not be translated.

3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to surface acoustic wave equipment called the vertical joint resonator mold surface acoustic wave filter which formed the comb mold polar zone (it is described as IDT an INTADIJITARU transducer and the following) which has two or more electrode fingers along plurality and the propagation direction of a surface acoustic wave, and the communication device using it.

[0002]

[Description of the Prior Art] As a band pass filter of RF stage of a portable telephone, the surface acoustic wave filter (surface acoustic wave equipment) is used widely. As each engine performance for which a band pass filter is asked, low loss, the high magnitude of attenuation, a broadband, etc. are mentioned. Many invention concerning each above-mentioned engine performance also in a surface acoustic wave filter is made.

[0003] It is removing the pitch of the conditions with which an electrode finger's is periodically located in a line in it through between two IDT(s) which adjoin each other like JP,5-267990,A as the approach of broadband-izing of the surface acoustic wave filter of a vertical joint resonator mold, and the electrode finger with which two adjacent IDT(s)'s specifically adjoin from 0.5 times of the wavelength decided by the pitch of an electrode finger, and the method of optimizing arrangement of resonance mode is used widely.

[0004]

[Problem(s) to be Solved by the Invention] However, in the above-mentioned conventional case, even if it could broadband-ize, the insertion loss had the problem of getting worse.

[0005] That is, if the distance between the electrode fingers with which each other is adjoined between two IDT(s) is removed from 0.5 times of the wavelength decided by the pitch of an electrode finger, the periodic continuity of the propagation path of a surface acoustic wave will worsen in the part. 36-degreeYcutX propagation LiTaO3 especially using a leakage surface acoustic wave (Leakey wave) 64-degreeYcutX propagation LiNbO3 etc. -- in the surface acoustic wave filter using a piezo-electric substrate, the loss by bulk wave radiation increased, and even if it could broadband-ize, the insertion loss (propagation loss) had the problem of getting worse.

[0006]

[Means for Solving the Problem] In order that the surface acoustic wave equipment of this invention may solve the above-mentioned problem, on a piezo-electric substrate IDT which has two or more electrode fingers meets in the propagation direction of a surface acoustic wave. Plurality, The pitch of some electrode fingers from the edge which is surface acoustic wave equipment of the vertical joint resonator mold currently formed, and adjoins other IDT(s) about at least one IDT It is characterized by being set up smaller than the pitch of other parts and setting up smaller than duty of the electrode finger of other parts the duty (henceforth [it is described as duty and] a metallization ratio) of the

electrode finger which made said pitch small.

[0007] In the surface acoustic wave filter of the vertical joint resonator mold which has two or more IDT(s) according to the above-mentioned configuration The pitch of some electrode fingers is made narrower than the pitch of the part of other of IDT from the edge where two IDT(s) adjoin each other. By setting up smaller than duty of the electrode finger of other parts, duty of the electrode finger (henceforth, ** pitch electrode finger) which furthermore narrowed this pitch It has the bandwidth more than the conventional technique and an EQC, and an insertion loss is small, and cannot cause proof-pressure degradation easily, and-izing of the electrode formation can be carried out [easy].

[0008] It is the wavelength decided by the pitch of lambdaI2 and other electrode fingers in the wavelength decided by the pitch of the electrode finger which the electrode finger which changed the pitch in the above-mentioned surface acoustic wave equipment to IDT of both which adjoin each other still more nearly mutually is formed [finger], respectively, and changed said pitch lambdaI1 It is the electrode finger pitch which two IDT(s) adjoin when it carries out 0.5lambdaI2 It is desirable to have carried out abbreviation coincidence.

[0009] It is the electrode finger pitch which two IDT(s) adjoin when the electrode finger which changed the pitch is formed to IDT of both which adjoin each other mutually, respectively according to the above-mentioned configuration 0.5lambdaI2 Since the continuity of the surface acoustic wave which spreads between each above IDT by having carried out abbreviation coincidence is securable, degradation of an insertion loss can be controlled.

[0010] every which adjoins each other still more nearly mutually with the above-mentioned surface acoustic wave equipment -- the wavelength decided by the pitch of lambdaI2 and other electrode fingers in the wavelength decided by the pitch of the electrode finger which the electrode finger which changed the pitch is formed [finger] in either of the IDT(s), and changed said pitch -- lambdaI1 ** -- when it carries out, it is desirable to have made 0.25lambdaI1+0.25lambdaI2 carry out abbreviation coincidence of the electrode finger pitch which two IDT(s)

adjoin

[0011] It is the electrode finger pitch which two IDT(s) adjoin when the electrode finger which changed the pitch is formed in each either of the IDT(s) which adjoins each other mutually according to the above-mentioned configuration 0.25lambdaI1+0.25lambdaI2 Since the continuity of the surface acoustic wave which spreads between each above IDT by having carried out abbreviation coincidence is securable, degradation of an insertion loss can be controlled.

[0012] It is the electrode finger pitch of the part where the electrode finger which is not changed with the electrode finger which changed said pitch in IDT adjoins each other which changed further the pitch of some electrode fingers from the edge where said IDT adjoins with the pitch of the electrode finger of other of IDT with the above-mentioned surface acoustic wave equipment 0.25lambdaI1+0.25lambdaI2 It is desirable to have carried out abbreviation coincidence.

[0013] It is the electrode finger pitch of the part where the electrode finger which is not changed with the electrode finger which changed said pitch according to the above-mentioned configuration adjoins each other 0.25lambdaI1+0.25lambdaI2 By having carried out abbreviation coincidence, the continuity of the surface acoustic wave between the electrode fingers which are not changed with the electrode finger which changed said adjacent pitch can be secured more, and degradation of an insertion loss can be controlled.

[0014] In the above-mentioned surface acoustic wave equipment, it is smaller than duty of the electrode finger of the part of other of IDT in duty of the electrode finger which made said pitch small, and good also as 0.45 or more. According to the above-mentioned configuration,-izing of the degradation control of an insertion loss can be carried out [certain] more by having been smaller than duty of the electrode finger of the part of other of IDT, and having made or more into 0.45 duty of the electrode finger which made the pitch small.

[0015] In order that other surface acoustic wave equipments of this invention may solve the aforementioned technical problem, on a piezo-electric substrate IDT

which has two or more electrode fingers meets in the propagation direction of a surface acoustic wave. Plurality, duty of the electrode finger which is surface acoustic wave equipment of the vertical joint resonator mold currently formed, and adjoins each other between which two IDT(s) at least is set up smaller than duty of the electrode finger of other parts. It is characterized by setting up smaller than electrode finger core spacing (electrode finger pitch) of other parts electrode finger core spacing which adjoins each other between two IDT(s).

[0016] According to the above-mentioned configuration, by having set up smaller than duty of the electrode finger of other parts duty of the electrode finger which adjoins each other between which two IDT(s) at least, a passband is large, and generating of an electrostatic discharge can be controlled, and-izing of the processing on manufacture can be carried out [easy].

[0017] With the above-mentioned surface acoustic wave equipment, you may have balanced - unbalance I/O further.

[0018] The communication device of this invention is characterized by using surface acoustic wave equipment given in above any they are, in order to solve said technical problem.

[0019] According to the above-mentioned configuration, especially, since it is made to low loss as the surface acoustic wave equipment which could also miniaturize the communication device using the above-mentioned surface acoustic wave equipment since the miniaturization was attained in the GHz band 100MHz or more, and was used was mentioned above, the surface acoustic wave equipment which has the function of a filter element or balanced - unbalance conversion can simplify circuitry, and can attain a miniaturization also from this point.

[0020]

[Embodiment of the Invention] It will be as follows if each gestalt of operation of this invention is explained based on drawing 1 R> 1 thru/or drawing 14 .

[0021] The [first gestalt of operation] Drawing 1 is the schematic drawing of the electrode of the surface acoustic wave filter (surface acoustic wave equipment) in

connection with the first gestalt of operation of this invention. The surface acoustic wave filter for EGSM(Extended Global System for Mobile Communications)-Rx (dispatch section) is mentioned as an example, and the first gestalt of future operations explains it.

[0022] the filter of the first gestalt of this operation shows to drawing 1 -- as -- 40 **5-degreeYcutX propagation LiTaO3 from -- the surface acoustic wave filter is formed with aluminum electrode on the becoming substrate 30. The surface acoustic wave filter has composition which carried out two-step cascade connection of the filter section 1 and the filter section 2.

[0023] Each filter sections 1 and 2 are vertical joint resonator mold filters same 3IDT type, and the same is said of the detail of an electrode design. Each filter sections 1 and 2 are arranged, respectively so that the propagation direction of those surface acoustic waves may become mutual almost parallel and each IDT may become symmetrical mutually to an intermediate cable (imaginary line) parallel to the above-mentioned propagation direction of each filter sections 1 and 2.

[0024] In the filter section 1, IDT 4 and 5 is arranged to right and left (both sides which met in the propagation direction of a surface acoustic wave) of IDT14, and each reflectors 6 and 7 are formed so that these IDT(s) 3, 4, and 5 may be put from right and left. In the filter section 2, IDT 16 and 17 is arranged to right and left (both sides which met in the propagation direction of a surface acoustic wave) of IDT15, and each reflectors 18 and 19 are formed so that these IDT(s) 15, 16, and 17 may be put from right and left. The terminal 9 by which the terminal 8 connected to IDT3 was connected to an input signal terminal and IDT15 is an output signal terminal.

[0025] The pitch of several electrode fingers which adjoin the part and it which adjoin each other and meet between IDT3 and IDT4 and between IDT3 and IDT5 is made narrower than other partial electrode fingers of IDT 3, 4, and 5 so that clearly from drawing 1 (part of the electrode finger 10 of drawing 1 , and the electrode finger 11). Incidentally, by drawing 1 , in order to make drawing brief,

the number of an electrode finger is shown few.

[0026] Moreover, duty of the electrode finger of the part of this electrode finger 10 and the electrode finger 11 is set up so that it may become smaller than duty of the electrode finger of other parts of IDT 3, 4, and 5.

[0027] The detailed design of the surface acoustic wave filter of a vertical joint resonator mold the wavelength decided by the pitch of the electrode finger which lambdaI2 and others are narrow and has not carried out wavelength decided by the pitch of the electrode finger (for example, electrode 10) which narrowed the pitch between IDT-IDT -- lambdaI1 **, when it carries out decussation width-of-face: -- 35.8lambdaI1IDT number (order of IDT4, IDT3, and IDT5): -- (4)2525(4) / (4)27(4) (number of the electrode finger with which the inside of a parenthesis made the pitch small)

IDT wavelength lambdaI1 : 4.19 micrometers and lambdaI2 : 3.90-micrometer reflector wavelength lambdaR:4.29-micrometer reflector number: -- 100 IDT-IDT spacing: -- each other is adjoined -- Wavelength lambdaI1 lambdaI2 The part inserted into each electrode finger adjoins each other spacing (spacing 12 of drawing 1):0.25lambdaI1+0.25lambdaI2. Wavelength lambdaI2 Spacing of the part inserted into the **** electrode finger : (Spacing 13 of drawing 1) 0.50lambdaI2IDT-reflector spacing : 0.50lambdaRIDTduty: -- wavelength -- lambdaI1 part [of a pitch] (electrode finger 14 of drawing 1): -- 0.73 waves -- lambdaI2 part [of a pitch] (electrode finger 10 and electrode finger 11 of drawing 1): -- 0.60 reflector duty:0.55 electrode-layer thickness: -- 0.08lambdaI1 it is .

[0028] As a comparison, the structure of the surface acoustic wave filter designed with the conventional technique is shown in drawing 2 as the first conventional example. the first conventional example -- the first gestalt of this operation -- the same -- 40 **5-degreeYcutX propagation LiTaO3 from -- the surface acoustic wave filter is formed with aluminum electrode on the becoming substrate 30.

[0029] The surface acoustic wave filter has the composition of having concatenated two steps of each filter sections 21 and 22. Each filter sections 21

and 22 are the surface acoustic wave filters of a 3IDT type vertical joint resonator mold as well as the first gestalt of this operation, and its detail of the two filter sections 21 and an electrode design of 22 is mutually the same. When the detailed design of each filter sections 21 and 22 sets to lambdaI wavelength mutually decided by the pitch of an equal electrode finger, Decussation width of face : A 56.7lambdaIIDT number : (Order of IDT23, IDT24, and IDT25) 23/33/23IDT wavelength lambdaI: 4.20-micrometer reflector wavelength lambdaR:4.28-micrometer reflector number: -- 110 IDT-IDT spacing: -- 0.31lambdaIIDT-reflector spacing: -- 0.50lambdaRIDTduty:0.73 reflector duty:0.61 electrode-layer thickness: -- it is 0.08lambdaI.

[0030] The first gestalt of this operation and the frequency characteristics of the first conventional example are shown in drawing 3 . As for the frequency characteristics of the first gestalt of this operation, it turns out that the insertion loss in a passband is sharply improved as compared with the first conventional example. If it sees by the minimum insertion loss, with the first gestalt of this operation, about 0.4dB will have improved with about 1.8dB to being about 2.2dB in the first conventional example.

[0031] Moreover, in the first conventional example, although the pass band width of 4.0dB is about 40MHz from through level, according to the first gestalt of this operation, the same bandwidth is obtained from through level by 3.4dB. That is, it means that about 0.6dB insertion loss had improved in [whole] the passband.

[0032] Why the insertion-loss improvement of only this was obtained is explained below. In the design of the surface acoustic wave filter of the vertical joint resonator mold of 3IDT type which does not use the ** pitch electrode finger of the first conventional example, when extending a passband, the passband was formed in the IDT-IDT spacing section other than zero-order mode and the secondary mode which shows IDT-IDT spacing to drawing 4 by considering as 0.25lambdaI order using three of resonance modes with the peak of the intensity distribution of a surface acoustic wave.

[0033] However, a part discontinuous in the propagation path of a surface

acoustic wave will occur by making IDT-IDT spacing into 0.25lambdaI order in this case. In this discontinuous part, since the component emitted as a bulk wave increased, the problem that a propagation loss became large had arisen.

[0034] On the other hand, in order to make small the component emitted as this bulk wave, when a part discontinuous as 0.50lambdaI order was lost for IDT-IDT spacing, it becomes impossible to have used the three modes like [when making IDT-IDT spacing into 0.25lambdaI order], and there was a problem that-izing could not be carried out [broadband].

[0035] The first gestalt of this operation reduces loss by the component emitted as a bulk wave like the first conventional example while being set up so that a passband can be formed using three resonance modes in order to solve these two problems.

[0036] That is, with the first gestalt of this operation, a passband can be formed now using three resonance modes by making partially the pitch of the electrode finger (for example, the electrode finger 10 and the electrode finger 11) of the part where IDT3 and each IDT 4 and 5 adjoin smaller than the pitch of the electrode finger (for example, electrode finger 14) of other parts. Furthermore, in the first gestalt of this operation, loss by the component emitted as a bulk wave like the first conventional example is reduced by setting up spacing (for example, spacing 13) of IDT3 and each IDT 4 and 5 by about 0.5 times the wavelength decided by the pitch of the electrode finger of IDT around it.

[0037] Moreover, since the propagation loss of the surface acoustic wave itself becomes small to the wavelength of the surface acoustic wave which has generally spread the inside of a propagation path when the period of an electrode finger is small, in a part for a ** pitch electrode finger part, it is effective in loss of a surface acoustic wave being reduced.

[0038] Consequently, with the first gestalt of this operation, as drawing 3 showed, it turns out that it has wide band width of face rather than the design of the first conventional example, and the small surface acoustic wave filter of an insertion loss is obtained.

[0039] Moreover, in the first gestalt of this operation, since duty of a ** pitch electrode finger is made narrower than duty of other electrode fingers, the gap between electrode fingers is 0.57 micrometers between 0.78 micrometers and other electrode fingers between ** pitch electrode fingers, and the minimum gap between electrode fingers is a gap between the electrode fingers of others other than a ** pitch electrode finger.

[0040] Generally, proof-pressure degradation of IDT of a surface acoustic wave filter is decided by the minimum gap between electrode fingers, and it tends to cause proof-pressure degradation, so that this value is small. Therefore, in the first gestalt of this operation, although the ** pitch electrode finger is used, the gap between the minimum electrode fingers turns into gaps between electrode fingers other than a ** pitch electrode finger, and the surface acoustic wave filter which cannot cause proof-pressure degradation in the case where a ** pitch electrode finger is not used, and an EQC, easily is obtained.

[0041] Moreover, since the gap between electrode fingers of a ** pitch electrode finger is larger than the gap between electrode fingers of other electrode fingers, in a production process, it is hard to generate the poor omission in this part, and electrode formation can be ensured [easily and].

[0042] On the other hand, when duty of an electrode finger is made small, the component emitted as a bulk wave increases the surface acoustic wave which spreads the substrate 30 top which has piezoelectric [of LT substrate etc.]. Consequently, a propagation loss becomes large and an insertion loss increases.

[0043] Since the component emitted as a bulk wave in the part of this ** pitch electrode finger increased like this invention also when only duty of a ** pitch electrode finger is made small, it was expected that a propagation loss becomes large.

[0044] Therefore, it investigated whether duty of a ** pitch electrode finger could be made to what extent small. The approach of investigation makes duty of a ** pitch electrode finger smaller than duty of the electrode finger of other parts with the configuration of drawing 1 , and investigated change of the propagation loss

accompanying it. The pitch of a ** pitch electrode finger is changed and the part from which an impedance changes in fact when changing duty is adjusted.
[0045] The value of the propagation loss when making duty small is shown in drawing 5 . A propagation loss is the value which deducted loss by the mismatching of an impedance, and the ohmic loss by resisted part of an electrode finger from the insertion loss in a passband here.
[0046] From drawing 5 , if duty is made small to 0.4, a propagation loss will increase to 1.7dB. It was 1.65dB when the propagation loss was similarly searched for in the first conventional example. Therefore, from drawing 5 , if duty is considered as 0.45 or more abbreviation, it can be said that a propagation loss can be suppressed equivalent or less than [it] to the first conventional example.
[0047] In a passband, the magnitude of a propagation loss is not based on a frequency, but takes an almost fixed value. Therefore, if duty is considered as 0.45 or more abbreviation, a propagation loss can be conventionally made small with a design in a passband below equivalent, consequently an insertion loss can be made small in a passband.
[0048] Moreover, each property in the first conventional example (when it is made equal, without making duty of the part which made the pitch small smaller than duty of the electrode finger of other parts like the first gestalt of this operation) is indicated to be the first gestalt of this operation to drawing 6 and drawing 7 . Drawing 6 is the frequency characteristics of the amplitude (insertion loss). Drawing 7 R> 7 is the frequency characteristics of VSWR (Voltage Standing Wave Ratio, voltage standing wave ratio). With the first gestalt of this operation, duty of the part which made the pitch small, a pitch, and decussation width of face are changed as follows to the first conventional example.
- wavelength -- lambdaI2 part [of a pitch] (electrode finger 10 and electrode finger 11 of drawing 1): -- pitch IDT wavelength lambdaI2 of the part which made 0.13 smallness and a pitch smaller than the first conventional example : the first conventional example -- 0.01-micrometer size and decussation width-of-face decussation width-of-face: -- the first conventional example -- 4.7lambdaI1 The

pitch other than Smallness duty The pitch of the part made small and decussation width of face were also changed for taking adjustment of an impedance.

[0049] As are shown in drawing 7 , and about 0.11 ****s of VSWR of the first conventional example in the passband of EGSM-Rx (925MHz - 960MHz) are set to 1.62 with the first gestalt of this operation to being 1.73 and it is further shown in drawing 6 R> 6, since the minimum insertion loss is large, flattening of the frequency characteristics of the insertion loss in a passband is carried out, and the deflection in a passband is small. At this time, from through level, since the pass band width in 4dB is almost the same in the first gestalt and the first conventional example of this operation, the maximum insertion loss in the passband which is an essential property, and the manufacture tolerance which realizes it are not getting worse.

[0050] As mentioned above, it sets in the surface acoustic wave filter of the vertical joint resonator mold which has three or more IDT(s) in this invention. The pitch of some electrode fingers from the edge where two IDT(s) adjoin is made narrower than the pitch of the electrode finger of the part of other of IDT. By making it smaller than duty of the electrode finger of other pitches, duty of the electrode finger which furthermore narrowed the pitch Pass band width is wide, an insertion loss and VSWR are small, electrode formation is easy, and the vertical joint resonator mold surface acoustic wave filter which cannot cause proof-pressure degradation easily is obtained.

[0051] The [second gestalt of operation] The surface acoustic wave filter concerning the second gestalt of operation of this invention is explained below based on drawing 8 and drawing 9 . Drawing 8 and drawing 9 are each above-mentioned outline block diagram of IDT, and it is the enlarged drawing of a part with which, as for drawing 8 , the outline block diagram of the whole surface acoustic wave filter adjoins each other, and, as for drawing 9 , each IDT adjoins each other.

[0052] With the second gestalt of this operation, the surface acoustic wave filter

is formed with aluminum electrode on the substrate 30. drawing 8 -- setting -- right and left (it meets in the propagation direction of a surface acoustic wave -- as) of IDT41 -- every -- IDT 42 and 43 is arranged, and each reflectors 44 and 45 are formed so that these IDT(s) 41, 42, and 43 may be put. Each terminal 46 connected to IDT 42 and 43 is an unbalanced input signal terminal. Each terminals 47 and 48 connected to each electrode finger part which IDT41 intersects mutually, respectively are balanced output signal terminals.

[0053] In drawing 8 , although each main spacing of the electrode finger 49 besides IDT41 and each adjoining ** of IDT42, IDT41, and IDT43, the electrode finger 50, the electrode finger 51, and the electrode finger 52 is smaller [the wavelength decided by the pitch of the electrode finger of IDT for broadband-izing] than 0.5 times, while neither has changed the main coordinate (it maintained), as for the electrode finger besides **, only the electrode digit is small.

[0054] therefore -- for example, it is shown in drawing 9 -- as -- every -- the gap 53 between electrode fingers of the electrode finger 51 of a part with which IDT 41 and 43 adjoins each other, and the electrode finger 52 is larger than [comparable as other gaps 60 between electrode fingers, or] it, and the gap 56 between electrode fingers of the electrode finger 51, the gap 55 between electrode fingers of the electrode finger 54 and the electrode finger 52, and the electrode finger 54 is larger than other gaps 60 between electrode fingers.

[0055] As a comparison, the enlarged drawing of a part with which IDT of the surface acoustic wave filter as the second conventional example adjoins drawing 10 is shown. Since the configuration of those other than between IDT-IDT is the same as that of the second gestalt of this operation, detailed explanation is omitted here. In drawing 10 , duty of each electrode finger 61 besides ** of the part which IDT adjoins is the same as duty of other electrode fingers 62, therefore the gap 63 between electrode fingers besides ** is small as compared with the other gaps 64 between electrode fingers.

[0056] Although mentioned with the second gestalt of this operation as the

second conventional example for a comparison of the case where the electrode finger (finger) 61 from a different direction counters like drawing 10 , when the electrode finger from the same direction counters, it is the same like drawing 11 .

[0057] Since the gap between electrode fingers besides ** which adjoins each other between IDT-IDT becomes larger to the same extent as other gaps between electrode fingers than it according to the structure of the second gestalt of this operation, in the etching process of a production process, it is prevented as compared with the second conventional example that poor aluminum etching occurs in this part.

[0058] Thereby, with the second gestalt of this operation, the acoustical discontinuous part of a surface wave does not occur in the part of the gap between electrode fingers besides ** which adjoins each other between IDT-IDT, property degradation by the increment in loss etc. is avoided, generating of the malfunction by the short circuit between signal terminals or between signal terminal-grounding terminals is prevented, and electrode formation in a production process can be ensured easily. Moreover, it is hard to generate the electrostatic discharge in the part of the gap between electrode fingers besides ** which adjoins each other between IDT-IDT.

[0059] In the second gestalt of this operation, although considered as 0.5 or less times of the wavelength it is decided in the pitch of an electrode finger that an IDT-IDT gap will be, the gap between electrode fingers besides ** which adjoins each other between IDT-IDT also in the case of 0.5 or more times becomes larger than the gap of other electrode fingers.

[0060] Therefore, in the case of 0.5 or more times of the wavelength it is decided in the pitch of an electrode finger that the pitch IDT-IDT gap of the electrode finger which adjoins each other between IDT-IDT will be, the acoustical discontinuous part of a surface wave does not occur in this part, and property degradation by the increment in loss etc. does not take place, the malfunction by the short circuit between signal terminals does not occur, and electrode formation in a production process can be performed easily. Moreover, it is hard to generate

the electrostatic discharge in this part.

[0061] As mentioned above, in the surface acoustic wave filter of the vertical joint resonator mold which has three or more IDT(s), by making smaller than duty of other electrode fingers duty of the electrode finger which adjoins between two IDT(s), pass band width is wide, electrode formation is easy in a production process, and the surface acoustic wave filter of the vertical joint resonator mold with which an electrostatic discharge cannot happen easily is obtained in this invention.

[0062] By the way, as the approach of broadband-izing of the surface acoustic wave filter of a vertical joint resonator mold, as indicated by JP,5-267990,A On the conditions and concrete target with which an electrode finger is periodically located in a line through between two adjacent IDT(s) By removing the pitch (IDT-IDT spacing) of the electrode finger with which two adjacent IDT(s) adjoin from 0.5 times of the wavelength (lambdaI) decided by the pitch of the electrode finger of IDT The method of optimizing the arrangement of resonance mode shown in drawing 4 R> 4 is used widely, and becoming a broadband surface acoustic wave filter by making it smaller than especially 0.5 times is known.

[0063] The value which asked drawing 12 for frequency spacing in the mode of B and C shown in drawing 4 when center frequency makes IDT-IDT spacing smaller than 0.5lambdaI in the vertical joint resonator mold surface acoustic wave filter for PCS-Rx which is 1960MHz by experiment is shown.

[0064] Spacing of the resonance mode of the surface wave of B and C which shows IDT-IDT spacing to drawing 4 by making it smaller than 0.5lambdaI can obtain breadth, consequently larger pass band width.

[0065] The surrounding electrode configuration between IDT-IDT when making this IDT-IDT spacing smaller than 0.5lambdaI is shown in drawing 13 . Since the main spacing 31 between electrode finger 34a which adjoins each other between two IDT(s)34 and 35, and 35a is smaller than 0.5lambdaI, only the gap 32 between electrode fingers in this part is narrow compared with the gap 33 between electrode fingers in other parts.

[0066] However, when the wavelength decided by the pitch of an electrode finger was smaller than 0.5 times and spacing of the electrode finger which adjoins each other between these two IDT(s)34 and 35 was carried out, only the gap between electrode fingers of this part became smaller than the gap between electrode fingers of other parts, and it had the problem of being easy to generate poor aluminum etching in a production process in this part.

[0067] Poor aluminum etching of this gap section had the problem of leading to property degradation of a filter by the increment in loss by the acoustical discontinuous part of a surface acoustic wave occurring etc.

[0068] Moreover, when one side of each of these adjacent electrode fingers 34a and 35a was [another side] a ground electrode in a signal electrode, in the case of the signal electrode, between signal terminals also short-circuited [one side] another side by poor aluminum etching with the signal electrode, and since the problem that a surface acoustic wave filter does not operate, and the gap were small, there was a problem of being easy to cause an electrostatic discharge in this part.

[0069] However, with the second gestalt of this operation, in the surface acoustic wave filter of the vertical joint resonator mold equipped with three or more IDT(s), a passband is large, and it is hard to cause an electrostatic discharge, and-izing of the processing on manufacture can be carried out [easy] by making smaller than duty of other electrode fingers duty of the electrode finger besides ** of the part which IDT adjoins.

[0070] Then, the communication device 100 which carried the surface acoustic wave equipment of a publication in the first of this operation and the second gestalt is explained, referring to drawing 14 .

[0071] As a receiver side (Rx side) which receives, the above-mentioned communication device 100 is equipped with an antenna 101, the antenna common section / RFTop filter 102, amplifier 103, Rx interstage filter 104, a mixer 105, the 1stIF filter 106, a mixer 107, the 2ndIF filter 108, the 1st+2nd local synthesizer 111, TCXO (temperature compensated crystal oscillator

(temperature-compensated crystal oscillator))112, a divider 113, and the local filter 114, and is constituted. As double lines showed, in order to secure balance nature from Rx interstage filter 104 to drawing 14 to a mixer 105, transmitting by each balanced signal is desirable.

[0072] Moreover, as a transceiver side (Tx side) which transmits, it has the TxIF filter 121, a mixer 122, Tx interstage filter 123, amplifier 124, a coupler 125, an isolator 126, and APC (automaticpower control)127 (APC), and the above-mentioned communication device 100 is constituted while sharing the above-mentioned antenna 101, and the above-mentioned above-mentioned antenna common section / RFTop filter 102.

[0073] And surface acoustic wave equipment given in the first of this operation and the second gestalt which were mentioned above can use for the above-mentioned Rx interstage filter 104, the 1stIF filter 106, the TxIF filter 121, and Tx interstage filter 123 suitably.

[0074] Therefore, since the used surface acoustic wave equipment has the bandwidth more than the former and an EQC, and the above-mentioned communication device has an insertion loss and small VSWR, and cannot cause proof-pressure degradation easily and can carry out [easy]-izing of the electrode formation, it can be attaining miniaturization, high-performance-izing, and low cost-ization in a miniaturization, high-performance-izing, low-cost-izing, and the communication device especially equipped with the passband more than a GHz band.

[0075]

[Effect of the Invention] duty of the electrode finger which the pitch of some electrode fingers from the edge where the surface acoustic wave equipment of this invention adjoins other IDT(s) about at least one IDT of IDT formed on the piezo-electric substrate as mentioned above was set up smaller than the pitch of other parts, and made said pitch small is a configuration set up smaller than duty of the electrode finger of other parts.

[0076] So, it has the bandwidth more than the conventional technique and an

EQC, and an insertion loss and VSWR are small, and cannot cause proof-pressure degradation easily, and the above-mentioned configuration does the effectiveness that-izing of the electrode formation can be carried out [easy].

[0077] IDT which has two or more electrode fingers on a piezo-electric substrate other surface acoustic wave equipments of this invention as mentioned above It is surface acoustic wave equipment of plurality and the vertical joint resonator mold currently formed along the propagation direction of a surface acoustic wave. It is the configuration of having set up smaller than duty of the electrode finger of other parts duty of the electrode finger which adjoins each other between which two IDT(s) at least, and having set up smaller than electrode finger core spacing (electrode finger pitch) of other parts electrode finger core spacing which adjoins each other between two IDT(s).

[0078] So, by having set up smaller than duty of the electrode finger of other parts duty of the electrode finger which adjoins each other between which two IDT(s) at least, the above-mentioned configuration has a large passband, and can control generating of an electrostatic discharge, and does the effectiveness that-izing of the processing on manufacture can be carried out [easy].

[0079] The communication device of this invention is the configuration of having used the above-mentioned surface acoustic wave equipment, as mentioned above. So, since the above-mentioned configuration used the surface acoustic wave equipment which has the bandwidth more than the former and an EQC, an insertion loss and VSWR are small, and cannot cause proof-pressure degradation easily, and can carry out [easy]-izing of the electrode formation, it does the effectiveness that high-performance-izing and low cost-ization can be attained.

[Translation done.]

* NOTICES *

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the outline block diagram of the surface acoustic wave filter concerning the first gestalt of operation of this invention.
[Drawing 2] It is the outline block diagram of the surface acoustic wave filter concerning the first conventional example for a comparison.
[Drawing 3] It is the graph which shows the insertion loss and passband of each surface acoustic wave filter concerning the first gestalt and the first conventional example of this operation, respectively.
[Drawing 4] (a) is a graph which shows broadband-ization by each three resonance modes, it is the explanatory view showing the frequency relation of the resonance mode in the surface acoustic wave filter of this invention, and (c) is [(b) is the outline block diagram of the surface acoustic wave filter for producing each / these / resonance mode and] the explanatory view showing active current distribution to show each three above-mentioned resonance modes, respectively.
[Drawing 5] It is the graph which shows the propagation loss when changing duty of a ** pitch electrode finger in the first gestalt of this operation.
[Drawing 6] It is the graph in the first gestalt and the first conventional example of this operation which shows the frequency characteristics of the amplitude (insertion loss), respectively.
[Drawing 7] It is the graph in the first gestalt and the first conventional example of

this operation which shows the frequency characteristics of VSWR, respectively.
[Drawing 8] It is the outline block diagram of the surface acoustic wave filter concerning the second gestalt of operation of this invention.
[Drawing 9] It is the important section enlarged drawing of the above-mentioned surface acoustic wave filter.
[Drawing 10] As a comparison, it is the outline block diagram of the surface acoustic wave filter of the second conventional example.
[Drawing 11] It is the outline block diagram showing other examples of the surface acoustic wave filter of the above-mentioned second conventional example.
[Drawing 12] It is the graph which shows the frequency of each resonance mode shown by drawing 4 , and relation with IDT-IDT spacing.
[Drawing 13] It is the important section enlarged drawing of above-mentioned IDT-IDT when making the above-mentioned IDT-IDT spacing into 0.5 or less times of the wavelength decided by the pitch of an electrode finger.
[Drawing 14] It is the important section block diagram of the communication device of this invention.
[Description of Notations]
3 IDT (Comb Mold Polar Zone)
4 IDT (Comb Mold Polar Zone)
5 IDT (Comb Mold Polar Zone)
10 Electrode Finger
11 Electrode Finger
30 Substrate (Piezo-electric Substrate)

[Translation done.]

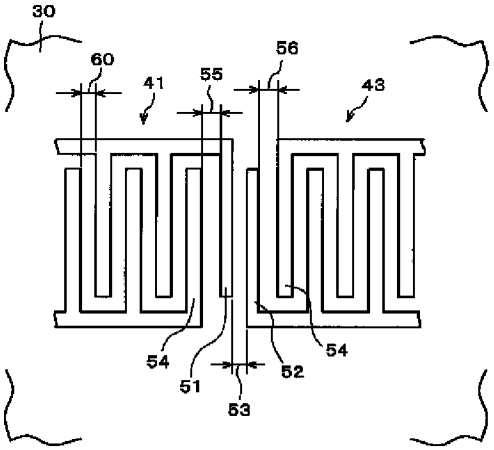
1.This document has been translated by computer. So the translation may not reflect the original precisely.

2.**** shows the word which can not be translated.

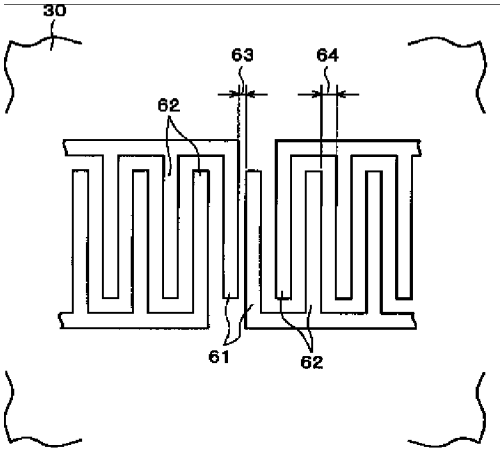
3.In the drawings, any words are not translated.

DRAWINGS

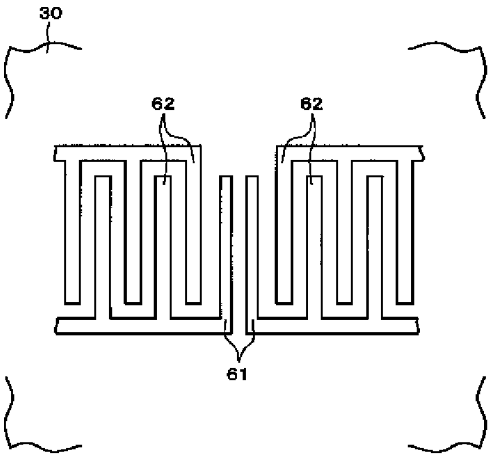
[Drawing 9]



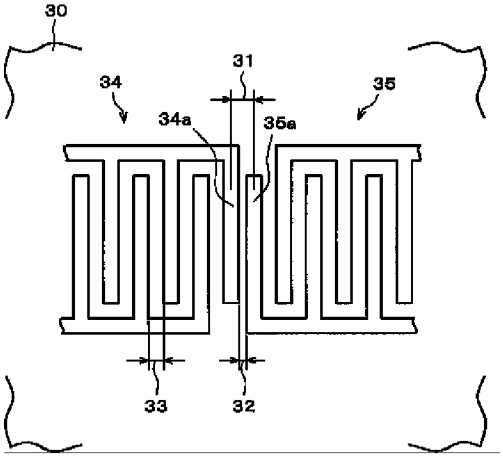
[Drawing 10]



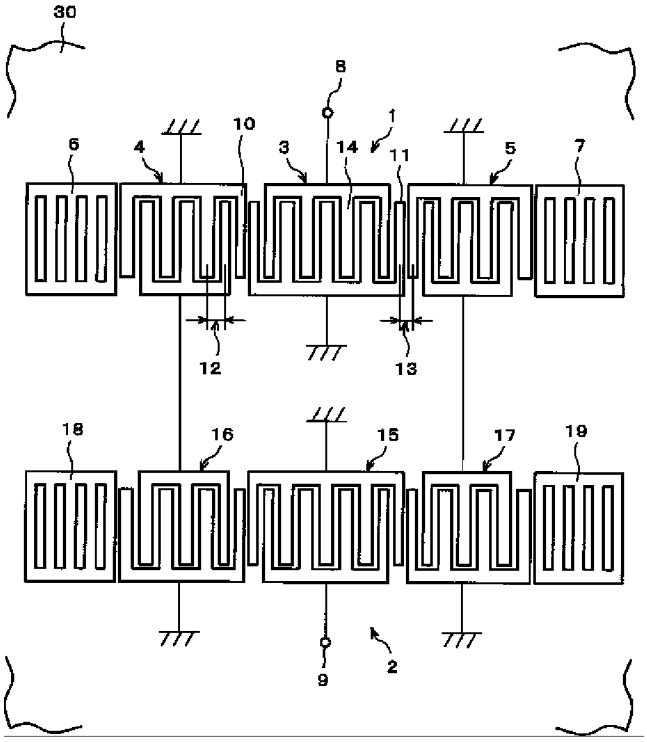
[Drawing 11]



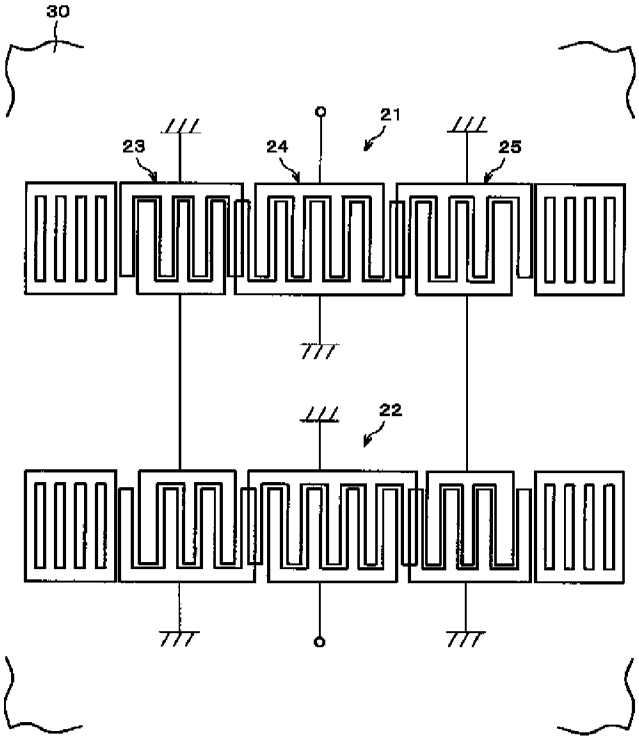
[Drawing 13]



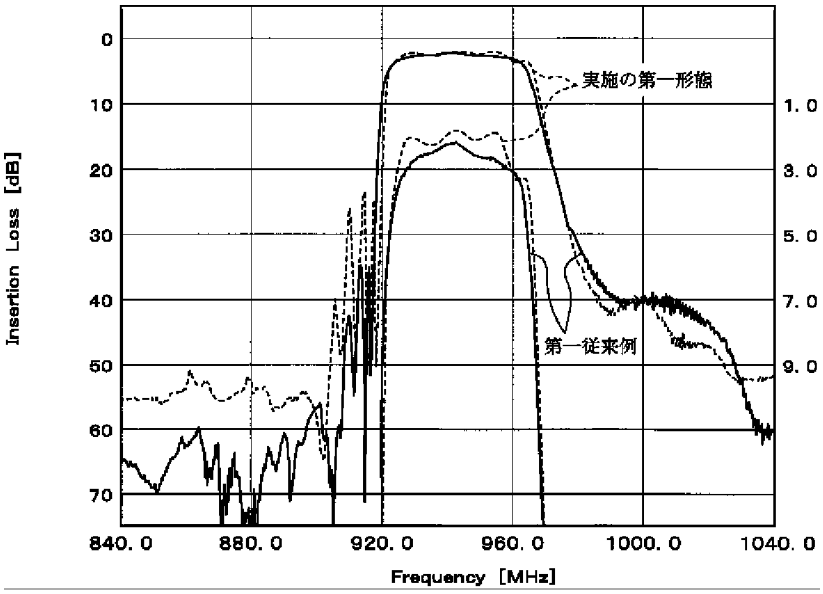
[Drawing 1]



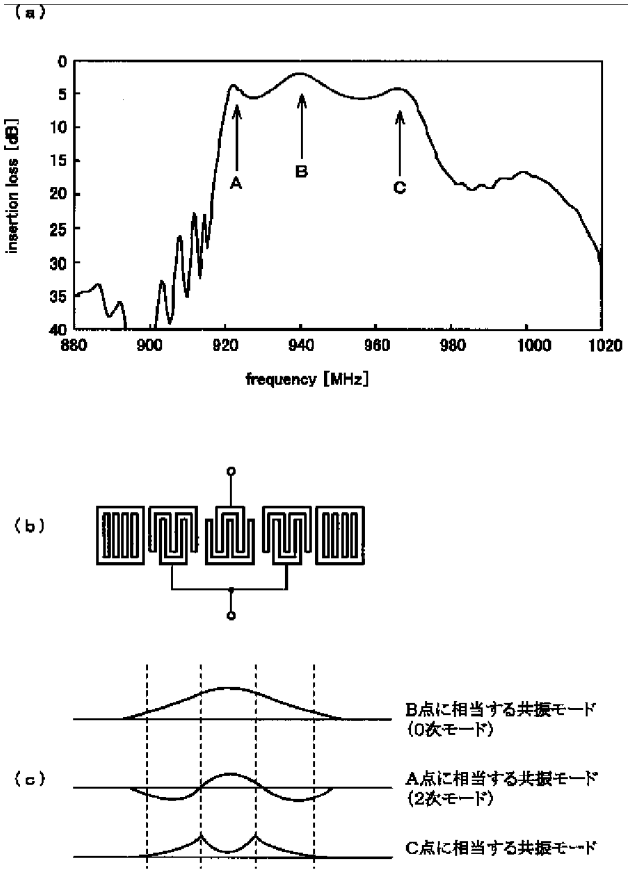
[Drawing 2]



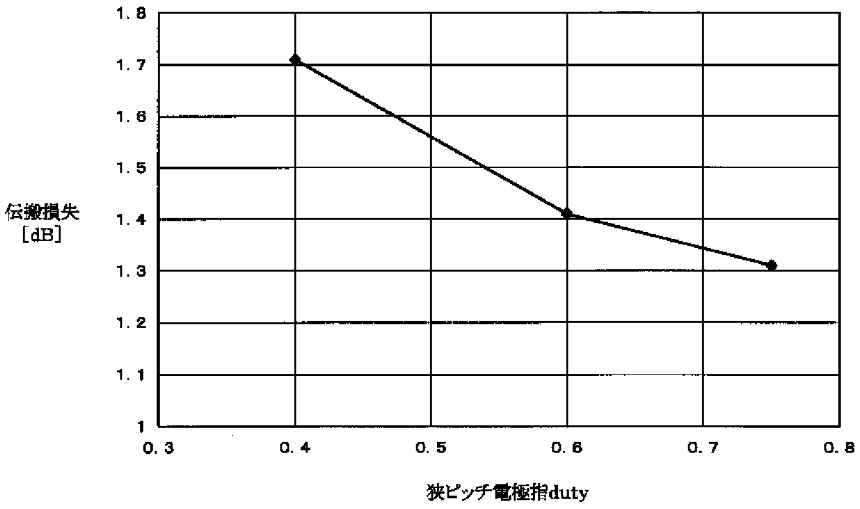
[Drawing 3]



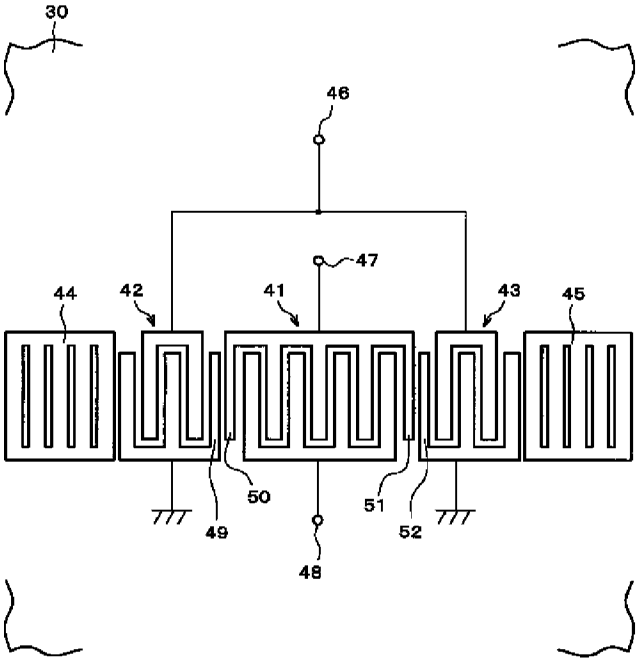
[Drawing 4]



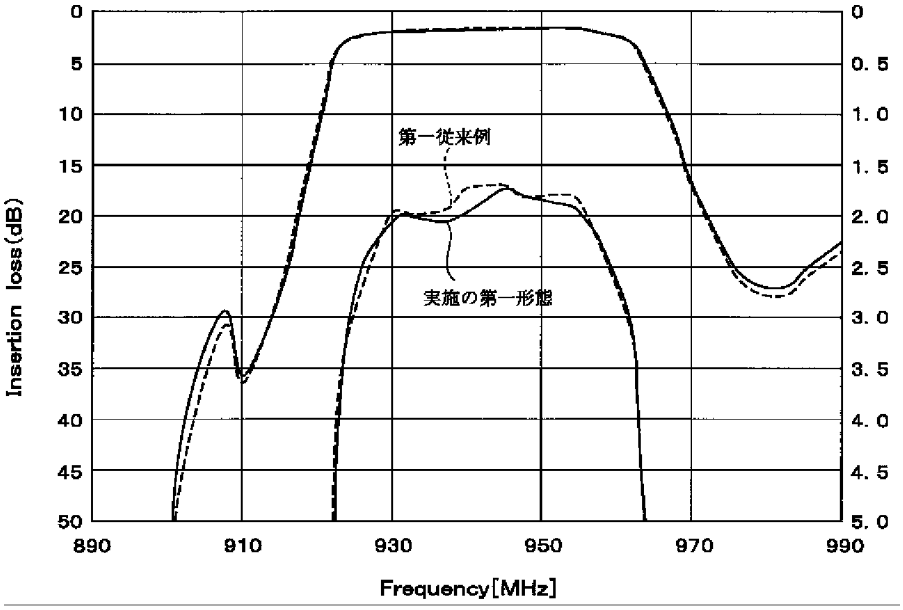
[Drawing 5]



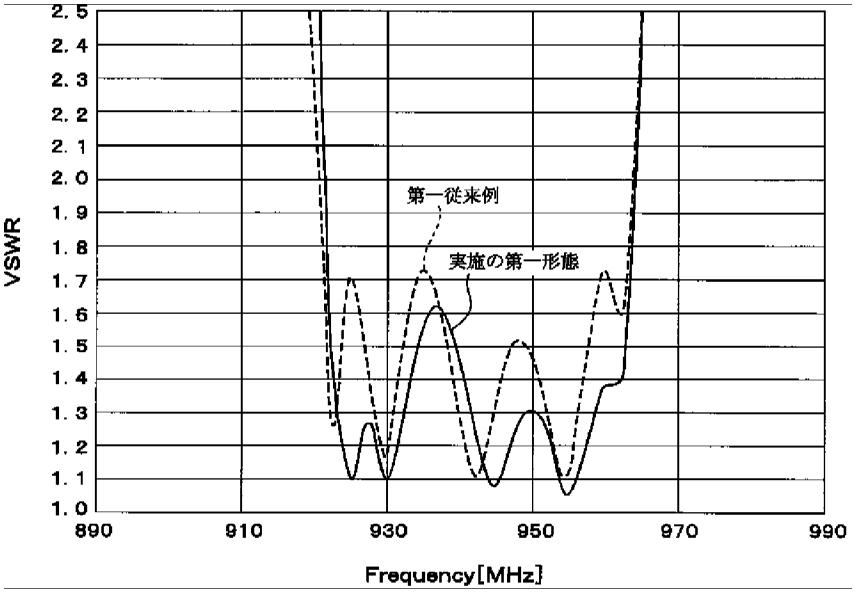
[Drawing 8]



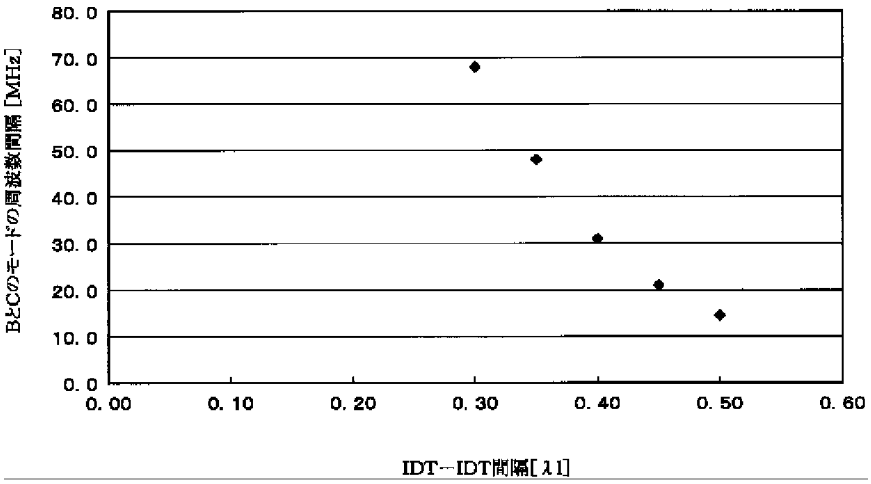
[Drawing 6]



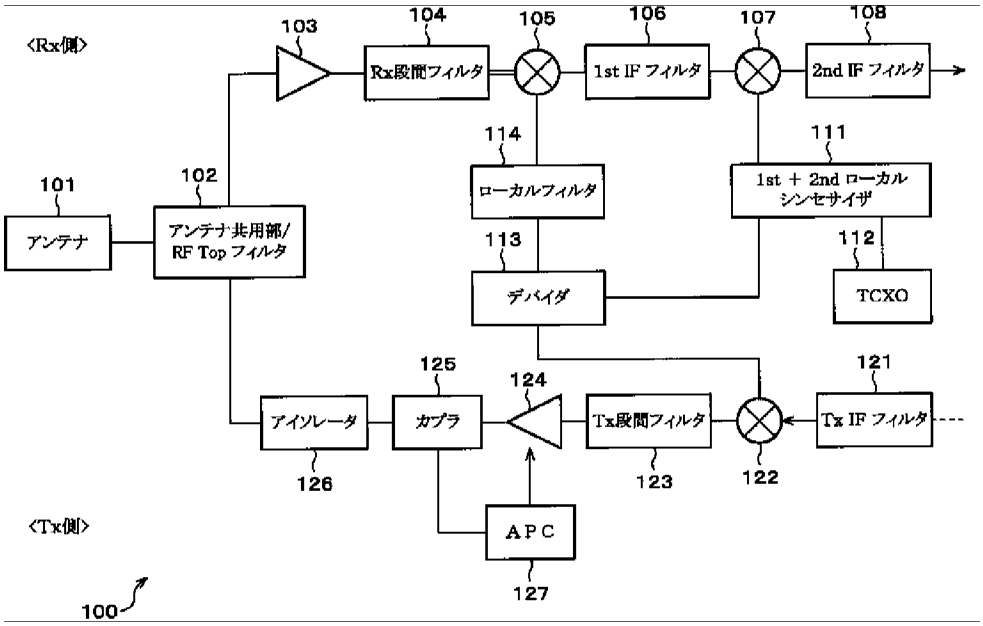
[Drawing 7]



[Drawing 12]



[Drawing 14]



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(73)特許権者　000006231
株式会社村田製作所
京都府長岡京市天神二丁目26番10号
(72)発明者　渡辺　寛隆
京都府長岡京市天神二丁目26番10号　株式会社村田製作所内
(72)発明者　高峰　裕一
京都府長岡京市天神二丁目26番10号　株式会社村田製作所内
(74)代理人　100080034
弁理士　原　謙三

審査官　清水　晃

最終頁に続く

(54)【発明の名称】　弾性表面波装置、通信装置

(57)【特許請求の範囲】
【請求項１】圧電基板上に、複数の電極指を有するくし型電極部が、弾性表面波の伝搬方向に沿って、複数、形成されている結合共振子型の弾性表面波装置であって、
少なくとも一つのくし型電極部について、他のくし型電極部に臨り合う端からの一部分の電極指のピッチは、他の部分のピッチより小さく設定され、
前記ピッチを小さくした電極指のデューティーは他の部分の電極指のデューティーより小さく設定されていることを特徴とする弾性表面波装置。
【請求項２】請求項１記載の弾性表面波装置において、互いに臨り合う両方のくし型電極部に対し、ピッチを異ならせた電極指がそれぞれ設けられ、
前記ピッチを異ならせた電極指のピッチで決まる波長を

λ１ｚ、その他の電極指のピッチで決まる波長をλ１ｉとしたとき、２つのくし型電極部が臨り合う電極指中心間距離を０．５λ１ｚに略一致させたことを特徴とする弾性表面波装置。
【請求項３】請求項１記載の弾性表面波装置において、互いに臨り合うくし型電極部の何れか一方にピッチを異ならせた電極指が設けられ、
前記ピッチを異ならせた電極指のピッチで決まる波長をλ１ｚ、その他の電極指のピッチで決まる波長をλ１ｉとしたとき、２つのくし型電極部が臨り合う電極指中心間距離を０．２５λ１ｉ＋０．２５λ１ｚに略一致させたことを特徴とする弾性表面波装置。
【請求項４】請求項２または３記載の弾性表面波装置において、
前記くし型電極部が隣接している端からの一部分の電極

3

指のピッチをそのくし型電極部の他の電極指のピッチと異ならせた、くし型電極部において、前記ピッチを異ならせた電極指と異ならせていない電極指が繰り合う箇所の電極指中心間距離を０．２５λ１：＋０．２５λ１ｚに略一致させたことを特徴とする弾性表面波装置。

【請求項５】請求項１ないし４の何れかに記載の弾性表面波装置において、

前記ピッチを小さくした電極指のデューティーを、そのくし型電極部の他の部分の電極指のデューティーより小さく、かつ０．４５以上としたことを特徴とする弾性表面波装置。

【請求項６】圧電基板上に、複数の電極指を有するくし型電極部が、弾性表面波の伝搬方向に沿って、複数、形成されている縦結合共振子型の弾性表面波装置であって、

少なくとも何れかの２つのくし型電極部間にて繰り合う電極指のデューティーを他の部分の電極指のデューティーより小さく設定し、

２つのくし型電極部間にて繰り合う電極指中心間隔を、他の部分の電極指中心間隔（電極指ピッチ）よりも小さく設定したことを特徴とする弾性表面波装置。

【請求項７】請求項１ないし６の何れかに記載の弾性表面波装置において、平衡－不平衡入出力を有していることを特徴とする弾性表面波装置。

【請求項８】請求項１ないし７の何れかに記載の弾性表面波装置を用いたことを特徴とする通信装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、複数の電極指を有するくし型電極部（インターディジタルトランスデューサ、以下、ＩＤＴと記す）を、複数、弾性表面波の伝搬方向に沿って形成した縦結合共振子型弾性表面波フィルタといった弾性表面波装置およびそれを用いた通信装置に関するものである。

【０００２】

【従来の技術】携帯電話機のＲＦ段のバンドパスフィルタとして、弾性表面波フィルタ（弾性表面波装置）が広く用いられている。バンドパスフィルタに求められる各性能としては低損失、高減衰量、広帯域などが挙げられる。弾性表面波フィルタでも、上記各性能に関する多くの発明がなされている。

【０００３】その中で、縦結合共振子型の弾性表面波フィルタの広帯域化の方法として、例えば特開平５－２６７９９０号公報などのように、繰り合う２つのＩＤＴ間を通して電極指が周期的に並ぶ条件、具体的には、繰り合う２つのＩＤＴの隣接する電極指の中心間距離を、電極指のピッチで決まる波長の０．５倍から外すことで、共振モードの励振を最適化するという方法が広く用いられている。

【０００４】

4

【発明が解決しようとする課題】しかしながら、上記従来の場合には、広帯域化することはできても、挿入損失は悪化してしまうという問題があった。

【０００５】つまり、２つのＩＤＴ間の繰り合う電極指間の距離を電極指のピッチで決まる波長の０．５倍から外すと、その部分で弾性表面波の伝搬路の周期的な連続性が悪くなる。特に漏洩弾性表面波（リーキー波）を用いる３６°ＹｃｕｔＸ伝搬ＬｉＴａＯ３や６４°ＹｃｕｔＸ伝搬ＬｉＮｂＯ３などの圧電基板を用いた弾性表面波フィルタにおいては、バルク波放射による損失が増大してしまい、結果、広帯域化することはできても、挿入損失（伝搬損失）は悪化してしまうという問題があった。

【０００６】

【課題を解決するための手段】本発明の弾性表面波装置は、上記の問題を解決するために、圧電基板上に、複数の電極指を有するＩＤＴが、弾性表面波の伝搬方向に沿って、複数、形成されている縦結合共振子型の弾性表面波装置であって、少なくとも一つのＩＤＴについて、他のＩＤＴに繰り合う端からの一部分の電極指のピッチは、他の部分のピッチより小さく設定され、前記ピッチを小さくした電極指のデューティー（以下、ｄｕｔｙと記し、また、メタライゼーションレシオともいう）は他の部分の電極指のｄｕｔｙより小さく設定されていることを特徴としている。

【０００７】上記構成によれば、複数のＩＤＴを有する縦結合共振子型の弾性表面波フィルタにおいて、２つのＩＤＴが繰り合う端から一部分の電極指のピッチを、そのＩＤＴの他の部分のピッチよりも狭くし、さらにこのピッチを狭くした電極指（以後、狭ピッチ電極指）のｄｕｔｙを他の部分の電極指のｄｕｔｙよりも小さく設定することで、従来技術と同等以上の帯域幅を有し、かつ、挿入損失が小さく、かつ、耐圧劣化を引き起こし難く、かつ、電極形成を容易化できる。

【０００８】上記弾性表面波装置においては、さらに、互いに繰り合う両方のＩＤＴに対し、ピッチを異ならせた電極指がそれぞれ設けられ、前記ピッチを異ならせた電極指のピッチで決まる波長をλ１ｚ、その他の電極指のピッチで決まる波長をλ１１としたとき、２つのＩＤＴが繰り合う電極指中心間距離を０．５λ１ｚに略一致させたことが好ましい。

【０００９】上記構成によれば、互いに繰り合う両方のＩＤＴに対し、ピッチを異ならせた電極指がそれぞれ設けられた場合に、２つのＩＤＴが繰り合う電極指中心間距離を０．５λ１ｚに略一致させたことにより、上記各ＩＤＴ間を伝搬する弾性表面波の連続性を確保できるので、挿入損失の劣化を抑制できる。

【００１０】上記弾性表面波装置では、さらに、互いに繰り合う各ＩＤＴの何れか一方にピッチを異ならせた電極指が設けられ、前記ピッチを異ならせた電極指のピッ

チで決まる波長をλI2、その他の電極指のピッチで決まる波長をλI1としたとき、２つのＩＤＴが隣り合う電極指中心間距離を０．２５λI1＋０．２５λI2に略一致させたことが好ましい。

【００１１】上記構成によれば、互いに隣り合うＩＤＴの何れか一方にピッチを異ならせた電極指が設けられた場合に、２つのＩＤＴが隣り合う電極指中心間距離を０．２５λI1＋０．２５λI2に略一致させたことにより、上記各ＩＤＴ間を伝搬する弾性表面波の連続性を確保できるので、挿入損失の劣化を抑制できる。

【００１２】上記弾性表面波装置では、さらに、前記ＩＤＴが隣接している端からの一部分の電極指のピッチをそのＩＤＴの他の電極指のピッチと異ならせた、ＩＤＴにおいて、前記ピッチを異ならせた電極指と異ならせていない電極指が隣り合う箇所の電極指中心間距離を０．２５λI1＋０．２５λI2に略一致させたことが好ましい。

【００１３】上記構成によれば、前記ピッチを異ならせた電極指と異ならせていない電極指が隣り合う箇所の電極指中心間距離を０．２５λI1＋０．２５λI2に略一致させたことにより、隣り合う前記ピッチを異ならせた電極指と異ならせていない電極指との間での弾性表面波の連続性をより確保できて、挿入損失の劣化を抑制できる。

【００１４】上記弾性表面波装置においては、前記ピッチを小さくした電極指のｄｕｔｙを、そのＩＤＴの他の部分の電極指のｄｕｔｙより小さく、かつ０．４５以上としてもよい。上記構成によれば、ピッチを小さくした電極指のｄｕｔｙを、そのＩＤＴの他の部分の電極指のｄｕｔｙより小さく、かつ０．４５以上としたことにより、挿入損失の劣化抑制をより確実化できる。

【００１５】本発明の他の弾性表面波装置は、前記の課題を解決するために、圧電基板上に、複数の電極指を有するＩＤＴが、弾性表面波の伝搬方向に沿って、複数、形成されている縦結合共振子型の弾性表面波装置であって、少なくとも何れかの２つのＩＤＴ間にて隣り合う電極指のｄｕｔｙを他の部分の電極指のｄｕｔｙより小さく設定し、２つのＩＤＴ間にて隣り合う電極指中心間隔を、他の部分の電極指中心間隔（電極指ピッチ）よりも小さく設定したことを特徴としている。

【００１６】上記構成によれば、少なくとも何れかの２つのＩＤＴ間にて隣り合う電極指のｄｕｔｙを他の部分の電極指のｄｕｔｙより小さく設定したことにより、通過帯域が広く、静電破壊の発生を抑制でき、かつ、製造上の加工を容易化できる。

【００１７】上記弾性表面波装置では、さらに、平衡－不平衡入出力を有していてもよい。

【００１８】本発明の通信装置は、前記課題を解決するために、上記の何れかに記載の弾性表面波装置を用いたことを特徴としている。

【００１９】上記構成によれば、フィルタ素子や平衡－不平衡変換の機能を有する弾性表面波装置は、特に１００ＭＨｚ以上のＧＨｚ帯域において、小型化を図れるので上記弾性表面波装置を用いた通信装置も小型化でき、また、用いた弾性表面波装置を前述したように低損失にできるので、回路構成を簡素化できて、この点からも小型化が図れる。

【００２０】

【発明の実施の形態】本発明の実施の各形態について図１ないし図１４に基づいて説明すれば、以下の通りである。

【００２１】（実施の第一形態）図１は、本発明の実施の第一形態に関わる弾性表面波フィルタ（弾性表面波装置）の電極の略図である。以後の実施の第一形態では、ＥＧＳＭ（Extended Global System for Mobile Communications）－Ｒｘ（受信部）用の弾性表面波フィルタを例に挙げて説明する。

【００２２】本実施の第一形態のフィルタでは、図１に示すように、４０±５°ＹｃｕｔＸ伝搬ＬｉＴａＯ3からなる基板３０上に弾性表面波フィルタがＡｌ電極により形成されている。弾性表面波フィルタは、フィルタ部１、フィルタ部２を２段縦続接続した構成となっている。

【００２３】各フィルタ部１，２は同じ３ＩＤＴタイプの縦結合共振子型フィルタであり、電極設計の詳細も同じである。各フィルタ部１，２は、それらの弾性表面波の伝搬方向が互いにほぼ平行となり、かつ、各フィルタ部１、２の上記伝搬方向と平行な中間線（仮想線）に対し各ＩＤＴが互いに対称となるようにそれぞれ配置されている。

【００２４】フィルタ部１では、ＩＤＴ１４の左右（弾性表面波の伝搬方向に沿った両側）にＩＤＴ４、５を配置し、これらのＩＤＴ３、４、５を左右から挟み込むように各リフレクタ６、７が形成されている。フィルタ部２では、ＩＤＴ１５の左右（弾性表面波の伝搬方向に沿った両側）にＩＤＴ１６、１７を配置し、これらのＩＤＴ１５、１６、１７を左右から挟み込むように各リフレクタ１８、１９が形成されている。ＩＤＴ３に接続された端子８は入力信号端子、ＩＤＴ１５に接続された端子９は出力信号端子である。

【００２５】図１から明らかなように、ＩＤＴ３とＩＤＴ４の間、およびＩＤＴ３とＩＤＴ５の間にて、隣り合って対面する部分およびそれに隣り合う数本の電極指のピッチを、ＩＤＴ３，４，５の他の部分電極指より狭くしている（図１の電極指１０と電極指１１の箇所）。ちなみに、図１では図を鮮明にするために電極指の本数を少なく示している。

【００２６】また、この電極指１０と電極指１１の箇所の電極指のｄｕｔｙはＩＤＴ３，４，５の他の部分の電極指のｄｕｔｙより小さくなるように設定している。

7

【００２７】縦結合共振子型の弾性表面波フィルタの詳細な設計は、ＩＤＴ－ＩＤＴ間のピッチを狭くした電極指（例えば電極１０）のピッチで決まる波長をλI2、その他の狭くしていない電極指のピッチで決まる波長をλI1としたとき、

交叉幅：３５．８λI1

ＩＤＴ本数（ＩＤＴ４、ＩＤＴ３、ＩＤＴ５の順）：２５（４）／（４）２７（４）／（４）２５本（カッコ内はピッチを小さくした電極指の本数）

ＩＤＴ波長λI1：４．１９μｍ、λI2：３．９０μｍ

リフレクタ波長λＲ：４．２９μｍ

リフレクタ本数：１００本

ＩＤＴ－ＩＤＴ間隔：

隣り合う、波長λI1とλI2の各電極指に挟まれた箇所の間隔（図１の間隔１２）：０．２５λI1＋０．２５λI2

隣り合う、波長λI2の各電極指に挟まれた箇所の間隔（図１の間隔１３）：０．５０λI2

ＩＤＴ－リフレクタ間隔：０．５０λＲ

ＩＤＴｄｕｔｙ：

波長がλI1のピッチの箇所（図１の電極指１４）：０．７３

波長がλI2のピッチの箇所（図１の電極指１０と電極指１１）：０．６０

リフレクタｄｕｔｙ：０．５５

電極膜厚：０．０８λI1である。

【００２８】比較として、従来技術で設計した弾性表面波フィルタの構造を図２に第一従来例として示す。第一従来例は本実施の第一形態と同じく、４０±５°ＹｃｕｔＸ伝搬ＬｉＴａＯ3からなる基板３０上に弾性表面波フィルタがＡｌ電極により形成されている。

【００２９】弾性表面波フィルタは、各フィルタ部３１、３２を２段縦続した構成となっている。各フィルタ部２１、２２は本実施の第一形態と同じく３ＩＤＴタイプの縦結合共振子型の弾性表面波フィルタであり、２つのフィルタ部２１、２２の電極設計の詳細は互いに同じである。各フィルタ部２１、２２の詳細な設計は、互いに等しい電極指のピッチで決まる波長をλIとしたとき、

交叉幅：５６．７λI

ＩＤＴ本数（ＩＤＴ２３、ＩＤＴ２４、ＩＤＴ２５の順）：２３／３３／２３本

ＩＤＴ波長λI：４．２０μｍ

リフレクタ波長λＲ：４．２８μｍ

リフレクタ本数：１１０本

ＩＤＴ－ＩＤＴ間隔：０．３１λI

ＩＤＴ－リフレクタ間隔：０．５０λＲ

ＩＤＴｄｕｔｙ：０．７３

リフレクタｄｕｔｙ：０．６１

8

電極膜厚：０．０９λIである。

【００３０】本実施の第一形態と第一従来例の周波数特性を図３に示す。本実施の第一形態の周波数特性は、第一従来例と比較して通過帯域内の挿入損失が大幅に改善されていることが分かる。最小挿入損失で見ると第一従来例では約２．２ｄＢであるのに対し、本実施の第一形態では約１．８ｄＢと、およそ０．４ｄＢ改善している。

【００３１】また、第一従来例ではスルーレベルから４．０ｄＢの通過帯域幅は約４０ＭＨｚであるが、本実施の第一形態ではスルーレベルから３．４ｄＢで同じ帯域幅が得られている。つまり、通過帯域内全体で、約０．６ｄＢの挿入損失が改善したことになる。

【００３２】これだけの挿入損失改善が得られた理由について以下に説明する。第一従来例の狭ピッチ電極指を用いない３ＩＤＴタイプの縦結合共振子型の弾性表面波フィルタの設計では、通過帯域を広げる場合に、ＩＤＴ－ＩＤＴ間隔を０．２５λＩ前後とすることで、図４に示す０次モード、２次モードの他に、ＩＤＴ－ＩＤＴ間隔部に弾性表面波の強度分布のピークを持つ共振モードの３つを使って通過帯域を形成していた。

【００３３】しかしながら、この場合には、ＩＤＴ－ＩＤＴ間隔を０．２５λＩ前後とすることで弾性表面波の伝搬経中に不連続な部分が発生する事になる。この不連続な部分ではバルク波として放出する成分が多くなってしまうため、伝搬損失が大きくなるという問題が生じていた。

【００３４】一方で、このバルク波として放出する成分を小さくするために、ＩＤＴ－ＩＤＴ間隔を０．５０λＩ前後として不連続な部分を無くした場合には、ＩＤＴ－ＩＤＴ間隔を０．２５λＩ前後とした時のように３つのモードが使えなくなり、広帯域化できないという問題があった。

【００３５】本実施の第一形態は、この２つの問題を解決するために、３つの共振モードを使って通過帯域を形成できるように設定されていると共に、第一従来例のようなバルク波として放出する成分による損失を低減したものである。

【００３６】つまり、本実施の第一形態では、ＩＤＴ３と各ＩＤＴ４、５が隣接する箇所の電極指（例えば電極指１０や電極指１１）のピッチを他の部分の電極指（例えば電極指１４）のピッチよりも部分的に小さくすることで３つの共振モードを使って通過帯域を形成できるようになっている。さらに、本実施の第一形態においては、ＩＤＴ３と各ＩＤＴ４、５との間隔（例えば間隔１３）をその周りのＩＤＴの電極指のピッチで決まる波長の約０．５倍に設定することで、第一従来例のようなバルク波として放出する成分による損失が低減される。

【００３７】また、一般的に伝搬路中を伝搬している弾性表面波の波長に対し電極指の周期が小さい場合、弾性

表面波そのものの伝搬損失が小さくなるので、狭ピッチ電極指部分では弾性表面波の損失が低減されるという効果もある。

【００３８】その結果、本実施の第一形態では、図３で示したように、第一従来例の設計よりも広い帯域幅を有し、かつ挿入損失の小さな弾性表面波フィルタが得られることが分かる。

【００３９】また、本実施の第一形態においては、狭ピッチ電極指のｄｕｔｙを他の電極指のｄｕｔｙよりも狭くしているため、電極指間のギャップは狭ピッチ電極指間で０．７８μｍ、他の電極指間で０．５７μｍとなっており、電極指間の最小ギャップは狭ピッチ電極指以外の他の電極指間のギャップとなっている。

【００４０】一般的に弾性表面波フィルタのＩＤＴの耐圧劣化は電極指間の最小ギャップによって決まり、この値が小さいほど、耐圧劣化を引き起こしやすい。そのため、本実施の第一形態においては、狭ピッチ電極指を用いているが、最小電極指間ギャップは狭ピッチ電極指以外の電極指間ギャップとなり、狭ピッチ電極指を用いない場合と同等に耐圧劣化を引き起こし難い弾性表面波フィルタが得られる。

【００４１】また、狭ピッチ電極指の電極指間ギャップが他の電極指の電極指間ギャップよりも大きくなっているため、製造工程においてこの部分での抜け不良が発生し難く、電極形成を容易に、かつ確実に行なえる。

【００４２】一方で、電極指のｄｕｔｙを小さくしていった場合、ＬＴ基板等の圧電性を有する基板３０上を伝搬する弾性表面波は、バルク波として放出される成分が増加する。その結果、伝搬損失が大きくなり、挿入損失が増大する。

【００４３】本発明のように、狭ピッチ電極指のｄｕｔｙのみを小さくした場合にも、この狭ピッチ電極指の部分でバルク波として放出される成分が増加するため、伝搬損失が大きくなることが予想された。

【００４４】そのため、狭ピッチ電極指のｄｕｔｙを、どの程度まで小さくすることができるかを調査した。調査の方法は、図１の構成で狭ピッチ電極指のｄｕｔｙを他の部分の電極指のｄｕｔｙよりも小さくしていき、それに伴う伝搬損失の変化を調べていった。実際には、ｄｕｔｙを変化させたときにインピーダンスが変化する分を、狭ピッチ電極指のピッチを変化させて調整している。

【００４５】図５にｄｕｔｙを小さくしていったときの伝搬損失の値を示す。ここで伝搬損失とは、通過帯域内の挿入損失からインピーダンスの不整合による損失、電極指の抵抗分によるオーミック損失を差し引いた値である。

【００４６】図５より、ｄｕｔｙを０．４まで小さくすると、伝搬損失は１．７ｄＢまで増大する。第一従来例で同じように伝搬損失を求めると、１．６５ｄＢであった。よって、図５より、ｄｕｔｙを約０．４５以上としておけば、第一従来例に対して伝搬損失を同等もしくはそれ以下に抑えることができると言える。

【００４７】伝搬損失の大きさは通過帯域内では周波数によらずほぼ一定の値を取る。そのため、ｄｕｔｙを約０．４５以上としておけば、通過帯域内において、伝搬損失を従来設計と同等以下に小さくでき、その結果、通過帯域内において挿入損失を小さくできる。

【００４８】また、本実施の第一形態と、第一従来例（本実施の第一形態のように、ピッチを小さくした部分のｄｕｔｙを他の部分の電極指のｄｕｔｙより小さくせずに等しくした場合）での各特性を、図６及び図７に示す。図６は、振幅（挿入損失）の周波数特性である。図７は、ＶＳＷＲ（Voltage Standing Wave Ratio、電圧定在波比）の周波数特性である。本実施の第一形態では、第一従来例に対し、ピッチを小さくした部分のｄｕｔｙ、ピッチ、交叉幅を以下のように変えている。

・波長がλ_2のピッチの箇所（図１の電極指１０と電極指１１）：第一従来例より０．１８小

・ピッチを小さくした部分のピッチ

ＩＤＴ波長λ_2：第一従来例より０．０１μｍ大

・交叉幅

交叉幅：第一従来例より４．７λ_1小

ｄｕｔｙの他にピッチを小さくした部分のピッチ、交叉幅も変更したのは、インピーダンスの整合を取るためである。

【００４９】図７に示すように、ＥＧＳＭ－Ｒｘの通過帯域内（９２５ＭＨｚ～９６０ＭＨｚ）における第一従来例のＶＳＷＲは１．７３であるのに対して、本実施の第一形態では１．６３と約０．１１改善され、さらに図６に示すように、最小挿入損失は大きくなっているため、通過帯域での挿入損失の周波数特性が平坦化され、通過帯域内での偏差が小さくなっている。このとき、スルーレベルから４ｄＢでの通過帯域幅は、本実施の第一形態と第一従来例とでほぼ同じであるため、重要特性である通過帯域内での最大挿入損失、及びそれを実現する製造公差は悪化していない。

【００５０】以上のように，本発明では３つ以上のＩＤＴを有する縦結合共振子型の弾性表面波フィルタにおいて、２つのＩＤＴが隣接している端からの一部分の電極指のピッチを、そのＩＤＴの他の部分の電極指のピッチよりも狭くして，さらにピッチを狭くした電極指のｄｕｔｙを他のピッチの電極指のｄｕｔｙよりも小さくすることで、通過帯域幅が広く、かつ、挿入損失及びＶＳＷＲが小さく、かつ、電極形成が容易で、かつ、耐圧劣化を引き起こしにくい縦結合共振子型弾性表面波フィルタが得られる。

【００５１】（実施の第二形態）本発明の実施の第二形態に係る弾性表面波フィルタについて、図８、図９に基づいて以下に説明する。図８、図９は、上記の各ＩＤＴ

の概略構成図であり、図８は弾性表面波フィルタ全体の概略構成図、図９は各ＩＤＴが譲り合う部分の拡大図である。

【００５２】本実施の第二形態では、基板３０上に弾性表面波フィルタがＡｌ電極により形成されている。図８において、ＩＤＴ４１の左右（弾性表面波の伝搬方向に沿うように）に各ＩＤＴ４２、４３を配置し、これらのＩＤＴ４１、４２、４３を挟み込むように各リフレクタ４４、４５が形成されている。各ＩＤＴ４２、４３に接続された端子４６は不平衡入力信号端子である。ＩＤＴ４１の互いに交叉している各電極指部にそれぞれ接続された、各端子４７、４８は平衡出力信号端子である。

【００５３】図９において、ＩＤＴ４１とＩＤＴ４２、ＩＤＴ４１とＩＤＴ４３のそれぞれの隣接する最外の電極指４９，電極指５０、電極指５１、電極指５２のそれぞれの中心間隔は、広帯域化のためＩＤＴの電極指のピッチで決まる波長の０．５倍よりも小さくなっているが、最外の電極指はいずれもその中心位置は変えない（維持した）まま電極指幅のみが小さくなっている。

【００５４】したがって、例えば図９に示す様に、各ＩＤＴ４１、４３が譲り合う部分の電極指５１と電極指５２の電極指間ギャップ５３は他の電極指間ギャップ６０と同程度もしくはそれ以上に大きく、電極指５１と電極指５４の電極指間ギャップ５５、電極指５３と電極指５４の電極指間ギャップ５６は他の電極指間ギャップ６０よりも大きくなっている。

【００５５】比較として、図１０に、第二従来例としての弾性表面波フィルタのＩＤＴが譲り合う部分の拡大図を示す。ＩＤＴ－ＩＤＴ間以外の構成は本実施の第二形態と同様であるので、ここでは詳細な説明は省略する。図１０において、ＩＤＴが譲り合う部分の最外の各電極指６１のｄｕｔｙは他の電極指６２のｄｕｔｙと同じになっており、そのため、最外の電極指間ギャップ６３はその他の電極指間ギャップ６４と比較して小さくなっている。

【００５６】本実施の第二形態では、図１０のように、異なる方向からの電極指（フィンガー）６１が対向する場合を比較のための第二従来例として挙げたが、図１１のように、同じ方向からの電極指が対向する場合においても、同様である。

【００５７】本実施の第二形態の構造によれば、ＩＤＴ－ＩＤＴ間にて譲り合う最外の電極指間ギャップが他の電極指間ギャップと同程度もしくはそれ以上に広くなるので、製造工程のエッチング工程において、この部分でＡｌエッチング不良の発生することが第二従来例と比較して防止される。

【００５８】これにより、本実施の第二形態では、ＩＤＴ－ＩＤＴ間にて譲り合う最外の電極指間ギャップの部分で表面波の音響的不連続部分が発生せず、損失増加などによる特性劣化が回避され、また、信号端子間、もしくは信号端子－アース端子間の短絡による動作不良の発生が防止され、かつ製造工程における電極形成を容易に確実に行うことができる。また、ＩＤＴ－ＩＤＴ間にて譲り合う最外の電極指間ギャップの部分での静電破壊が発生し難い。

【００５９】本実施の第二形態においては、ＩＤＴ－ＩＤＴギャップが電極指のピッチで決まる波長の０．５倍以下としているが、０．５倍以上の場合にも、ＩＤＴ－ＩＤＴ間にて譲り合う最外の電極指間ギャップがその他の電極指のギャップより大きくなる。

【００６０】そのため、ＩＤＴ－ＩＤＴ間にて譲り合う電極指の中心間距離ＩＤＴ－ＩＤＴギャップが電極指のピッチで決まる波長の０．５倍以上の場合においても、この部分で表面波の音響的不連続部分が発生せず、損失増加などによる特性劣化が起こらず、また、信号端子間の短絡による動作不良が発生せず、かつ製造工程における電極形成を容易に行うことができる。また、この部分での静電破壊が発生し難い。

【００６１】以上のように、本発明では３つ以上のＩＤＴを有する縦結合共振子型の弾性表面波フィルタにおいて、２つのＩＤＴ間に隣接する電極指のｄｕｔｙを他の電極指のｄｕｔｙよりも小さくすることにより、通過帯域幅が広く、かつ、製造工程において電極形成が容易で，かつ静電破壊が起こり難い縦結合共振子型の弾性表面波フィルタが得られる。

【００６２】ところで、縦結合共振子型の弾性表面波フィルタの広帯域化の方法として、例えば特開平６－２６７９９０号公報に開示されているように、譲り合う２つのＩＤＴ間を通して電極指が周期的に並ぶ条件、具体的には、譲り合う２つのＩＤＴの隣接する電極指の中心間距離（ＩＤＴ－ＩＤＴ間隔）を、ＩＤＴの電極指のピッチで決まる波長（λＩ）の０．５倍から外すことで、図４に示す共振モードの配置を最適化するという方法が広く用いられており、特に０．５倍よりも小さくすることで広帯域な弾性表面波フィルタとなることが知られている。

【００６３】図１２に，中心周波数が１９８０ＭＨｚのＰＣＳ－Ｒｘ用縦結合共振子型弾性表面波フィルタにおいて，ＩＤＴ－ＩＤＴ間隔を０．５λＩよりも小さくしていった時の図４に示すＢとＣのモードの周波数間隔を実験により求めた値を示す。

【００６４】ＩＤＴ－ＩＤＴ間隔を０．５λＩよりも小さくすることで，図４に示すＢとＣの表面波の共振モードの間隔が広がり，その結果，より広い通過帯域幅を得ることができる。

【００６５】図１３に，このＩＤＴ－ＩＤＴ間隔を０．５λＩよりも小さくしたときのＩＤＴ－ＩＤＴ間の周辺の電極構成を示す。２つのＩＤＴ３４，３５間に譲り合う電極指３４ａ、３５ａ間の中心間隔３１が０．５λＩよりも小さくなっているため、この部分での電極指間ギ

ャップ３２のみが他の部分での電極指間ギャップ３３に比べて狭くなっている。

【００６６】しかしながら、この２つのＩＤＴ３４、３５間にて隣り合う電極指の間隔を電極指のピッチで決まる波長の０．５倍より小さくした場合には、この部分の電極指間ギャップのみが他の部分の電極指間ギャップよりも小さくなり、この部分において製造工程においてＡｌエッチング不良が発生しやすいという問題を有していた。

【００６７】このギャップ部のＡｌエッチング不良は、弾性表面波の音響的不連続部分が発生することによる損失増加等によりフィルタの特性劣化につながるという問題があった。

【００６８】また、この隣り合う各電極指３４ａ、３５ａの一方がシグナル電極で、もう一方がアース電極の場合、もしくは一方がシグナル電極でもう一方もシグナル電極の場合には、Ａｌエッチング不良によって信号端子間が短絡され、弾性表面波フィルタが動作しないという問題、また、ギャップが小さいために、この部分で静電破壊を引き起こしやすいという問題があった。

【００６９】しかしながら、本実施の第二形態では、３つ以上のＩＤＴを備えた縦結合共振子型の弾性表面波フィルタにおいて、ＩＤＴが隣接する部分の最外の電極指のｄｕｔｙを他の電極指のｄｕｔｙよりも小さくすることで、通過帯域が広く、静電破壊を引き起こし難く、かつ、製造上の加工を容易化できる。

【００７０】続いて、図１４を参照しながら、本実施の第一および第二形態に記載の弾性表面波装置を搭載した通信装置１００について説明する。

【００７１】上記通信装置１００は、受信を行うレシーバ側（Ｒｘ側）として、アンテナ１０１、アンテナ共用部／ＲＦＴｏｐフィルタ１０２、アンプ１０３、Ｒｘ段間フィルタ１０４、ミキサ１０５、１ｓｔＩＦフィルタ１０６、ミキサ１０７、２ｎｄＩＦフィルタ１０８、１ｓｔ＋２ｎｄローカルシンセサイザ１１１、ＴＣＸＯ（temperature compensated crystal oscillator（温度補償型水晶発振器））１１２、デバイダ１１３、ローカルフィルタ１１４を備えて構成されている。Ｒｘ段間フィルタ１０４からミキサ１０５へは、図１４に二本線で示したように、バランス性を確保するために各平衡信号にて送信することが好ましい。

【００７２】また、上記通信装置１００は、送信を行うトランシーバ側（Ｔｘ側）として、上記アンテナ１０１および上記アンテナ共用部／ＲＦＴｏｐフィルタ１０２を共用するとともに、ＴｘＩＦフィルタ１２１、ミキサ１２２、Ｔｘ段間フィルタ１２３、アンプ１２４、カプラ１２５、アイソレータ１２６、ＡＰＣ（automatic power control（自動出力制御））１２７を備えて構成されている。

【００７３】そして、上記のＲｘ段間フィルタ１０４、

１ｓｔＩＦフィルタ１０６、ＴｘＩＦフィルタ１２１、Ｔｘ段間フィルタ１２３には、上述した本実施の第一および第二形態に記載の弾性表面波装置が好適に利用できる。

【００７４】よって、上記通信装置は、用いた弾性表面波装置が、従来と同等以上の帯域幅を有し、挿入損失及びＶＳＷＲが小さく、耐圧劣化を引き起こし難く、かつ、電極形成を容易化できるものであるので、小型化や高性能化や低コスト化、特にＧＨｚ帯域以上の通過帯域を備えた通信装置において小型化、高性能化および低コスト化を図れるものとなっている。

【００７５】

【発明の効果】本発明の弾性表面波装置は、以上のように、圧電基板上に形成されたＩＤＴの少なくとも一つのＩＤＴについて、他のＩＤＴに隣り合う端からの一部分の電極指のピッチは、他の部分のピッチより小さく設定され、前記ピッチを小さくした電極指のｄｕｔｙは他の部分の電極指のｄｕｔｙより小さく設定されている構成である。

【００７６】それゆえ、上記構成は、従来技術と同等以上の帯域幅を有し、かつ、挿入損失及びＶＳＷＲが小さく、かつ、耐圧劣化を引き起こし難く、かつ、電極形成を容易化できるという効果を奏する。

【００７７】本発明の他の弾性表面波装置は、以上のように、圧電基板上に、複数の電極指を有するＩＤＴが、弾性表面波の伝搬方向に沿って、複数、形成されている縦結合共振子型の弾性表面波装置であって、少なくとも何れかの２つのＩＤＴ間にて隣り合う電極指のｄｕｔｙを他の部分の電極指のｄｕｔｙより小さく設定し、２つのＩＤＴ間にて隣り合う電極指中心間隔を、他の部分の電極指中心間隔（電極指ピッチ）よりも小さく設定した構成である。

【００７８】それゆえ、上記構成は、少なくとも何れかの２つのＩＤＴ間にて隣り合う電極指のｄｕｔｙを他の部分の電極指のｄｕｔｙより小さく設定したことにより、通過帯域が広く、静電破壊の発生を抑制でき、かつ、製造上の加工を容易化できるという効果を奏する。

【００７９】本発明の通信装置は、以上のように、上記弾性表面波装置を用いた構成である。それゆえ、上記構成は、従来と同等以上の帯域幅を有し、挿入損失及びＶＳＷＲが小さく、耐圧劣化を引き起こし難く、かつ、電極形成を容易化できる弾性表面波装置を用いたので、高性能化や低コスト化を図れるという効果を奏する。

【図面の簡単な説明】

【図１】本発明の実施の第一形態に係る弾性表面波フィルタの概略構成図である。

【図２】比較のための第一従来例に係る弾性表面波フィルタの概略構成図である。

【図３】本実施の第一形態と第一従来例とに係る各弾性表面波フィルタの挿入損失および通過帯域をそれぞれ示

15

すグラフである。

【図４】本発明の弾性表面波フィルタにおける共振モードの周波数関係を示す説明図であって、（ａ）は３つの各共振モードによる広帯域化を示すグラフであり、（ｂ）はそれら各共振モードを生じるための弾性表面波フィルタの概略構成図であり、（ｃ）は上記３つの各共振モードをそれぞれ示すための有効電流分布を示す説明図である。

【図５】本実施の第一形態における、狭ピッチ電極指のｄｕｔｙを変化させたときの伝達損失を示すグラフである。

【図６】本実施の第一形態と、第一従来例とにおける、振幅（挿入損失）の周波数特性をそれぞれ示すグラフである。

【図７】本実施の第一形態と、第一従来例とにおける、ＶＳＷＲの周波数特性をそれぞれ示すグラフである。

【図８】本発明の実施の第二形態に係る弾性表面波フィルタの概略構成図である。

16

【図９】上記弾性表面波フィルタの要部拡大図である。

【図１０】比較として、第二従来例の弾性表面波フィルタの概略構成図である。

【図１１】上記第二従来例の弾性表面波フィルタの他の例を示す概略構成図である。

【図１２】図４にて示した各共振モードの周波数と、ＩＤＴ－ＩＤＴ間隔との関係を示すグラフである。

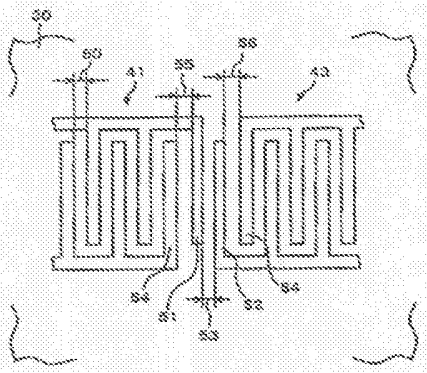
【図１３】上記ＩＤＴ－ＩＤＴ間隔を電極指のピッチで決まる波長の０．５倍以下としたときの上記ＩＤＴ－ＩＤＴの要部拡大図である。

【図１４】本発明の通信装置の要部ブロック図である。

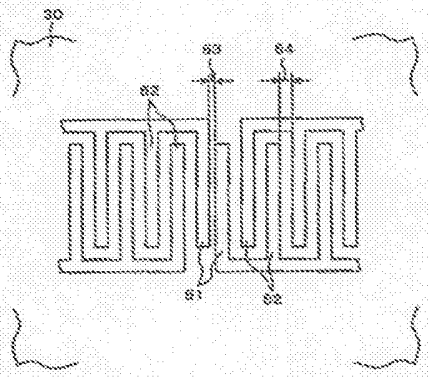
【符号の説明】

３　　ＩＤＴ（くし型電極部）
４　　ＩＤＴ（くし型電極部）
５　　ＩＤＴ（くし型電極部）
１０　　電極指
１１　　電極指
３０　　基板（圧電基板）

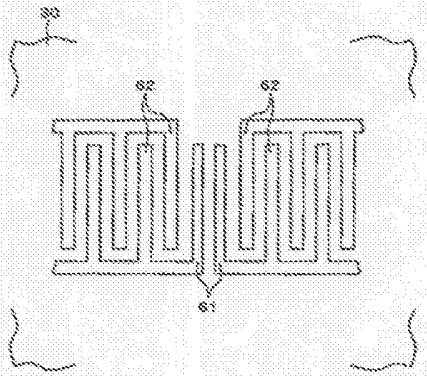
【図９】



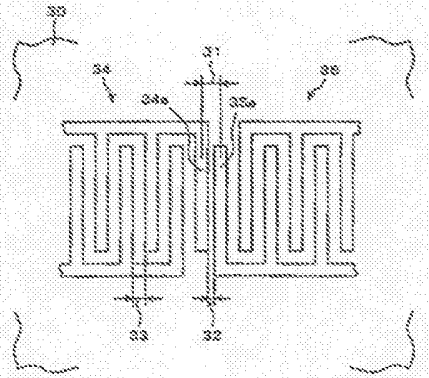
【図１０】



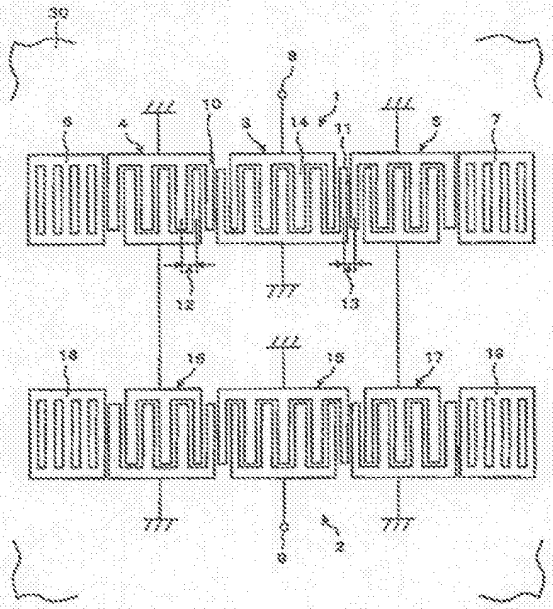
【図１１】



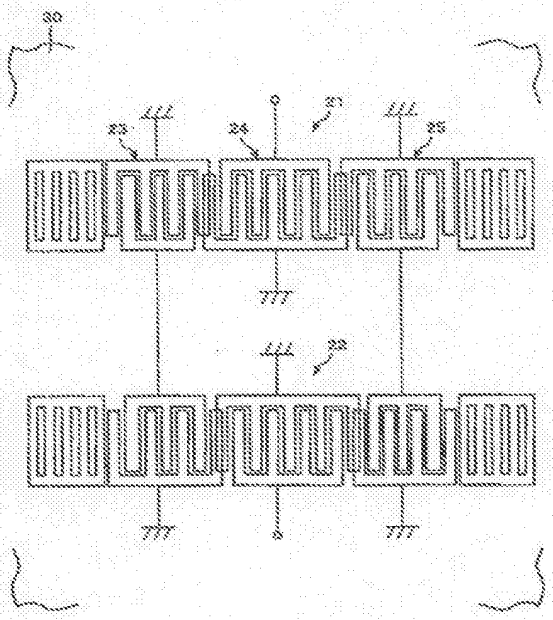
【図１３】



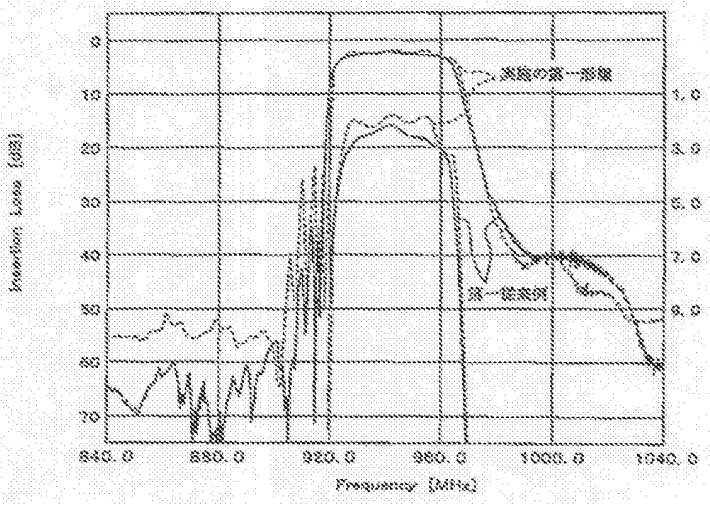
【図１】



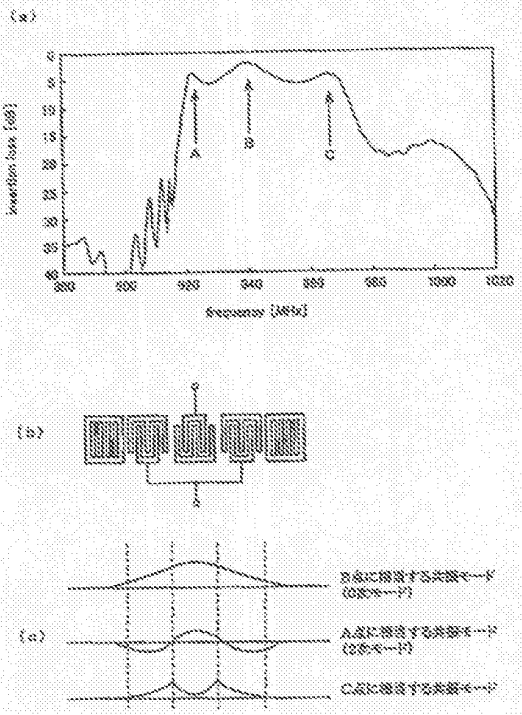
【図２】



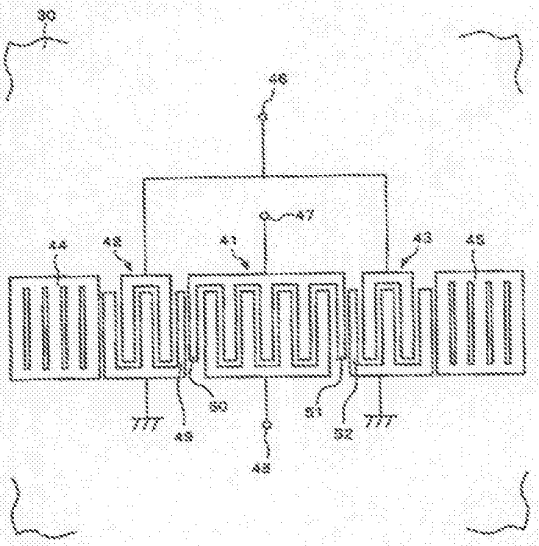
【図３】


Insertion Loss [dB]
0
10
20
30
40
50
60
70
840.0
880.0
920.0
960.0
1000.0
1040.0
Frequency [MHz]
1.0
3.0
5.0
7.0
9.0

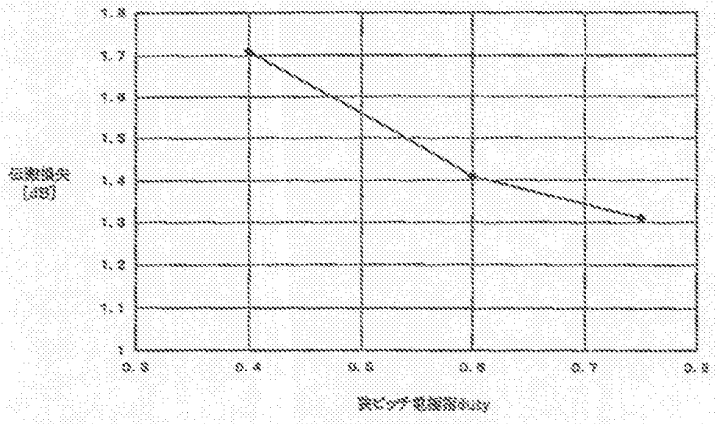
【図４】


(a)
Insertion loss [dB]
Frequency [MHz]
A
B
C
(b)
(c)

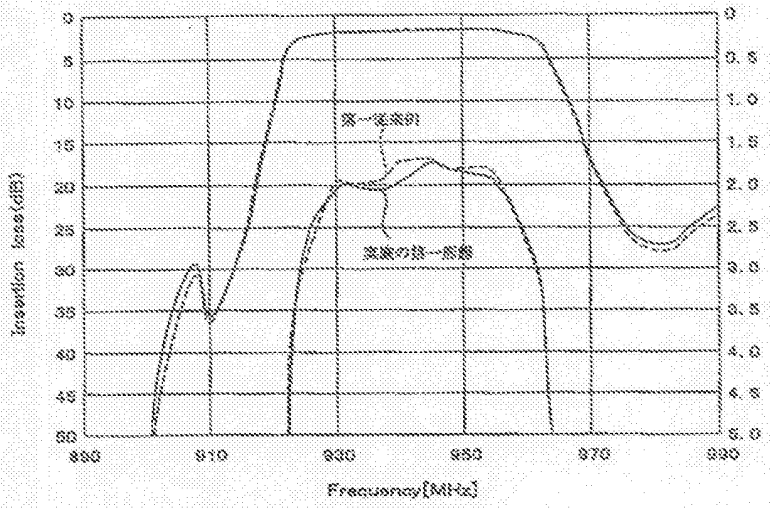
【図６】


30
46
47
44
42
41
43
45
777
48
50
52

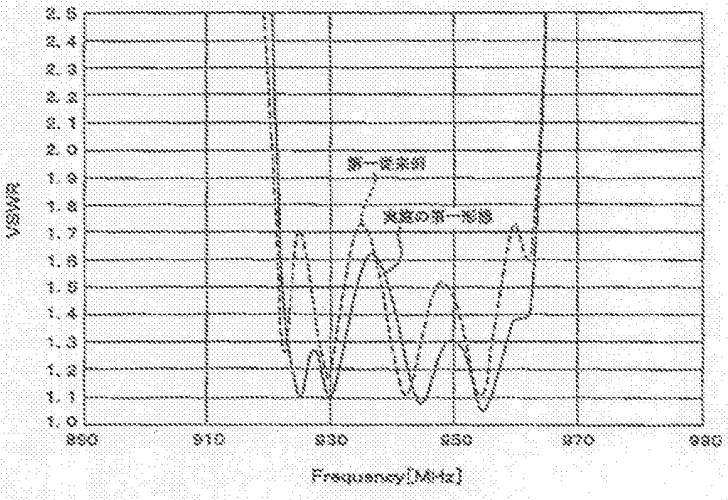
【図５】


1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
0.3
0.4
0.5
0.6
0.7
0.8

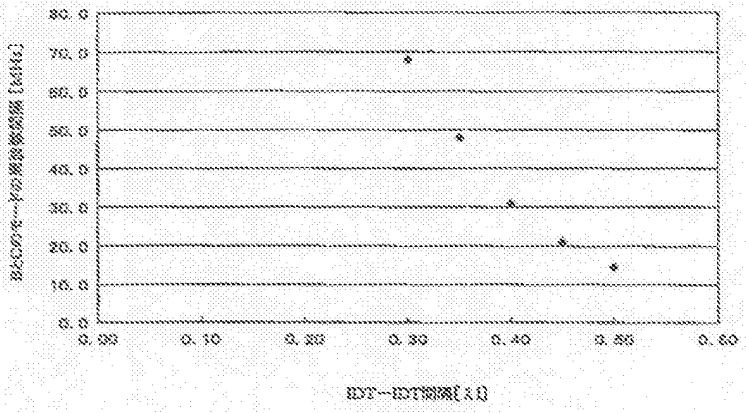
【図６】


Insertion loss(dB)
Frequency[MHz]
第一実施例
実施の第一形態

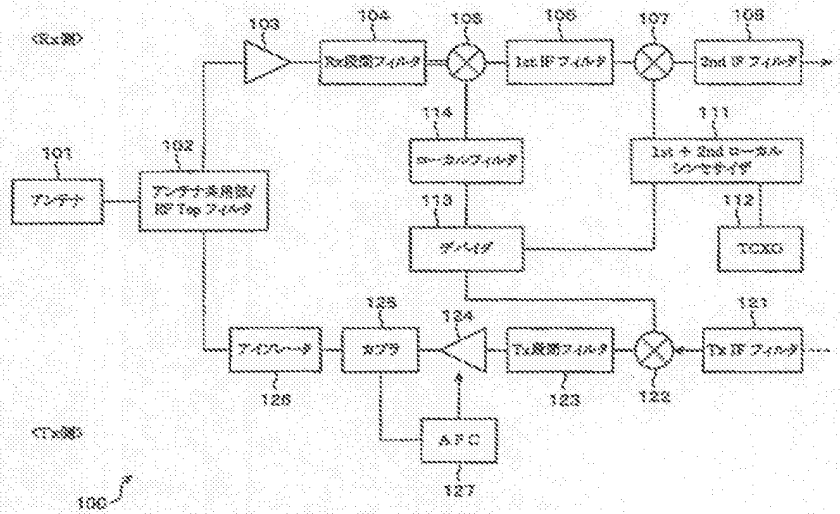
【図７】


VSWR
Frequency[MHz]
第一実施例
実施の第一形態

【図１２】



【図１４】



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(58)調査した分野(Int.Cl.⁷，ＤＢ名)
H03H　9/145
H03H　9/64